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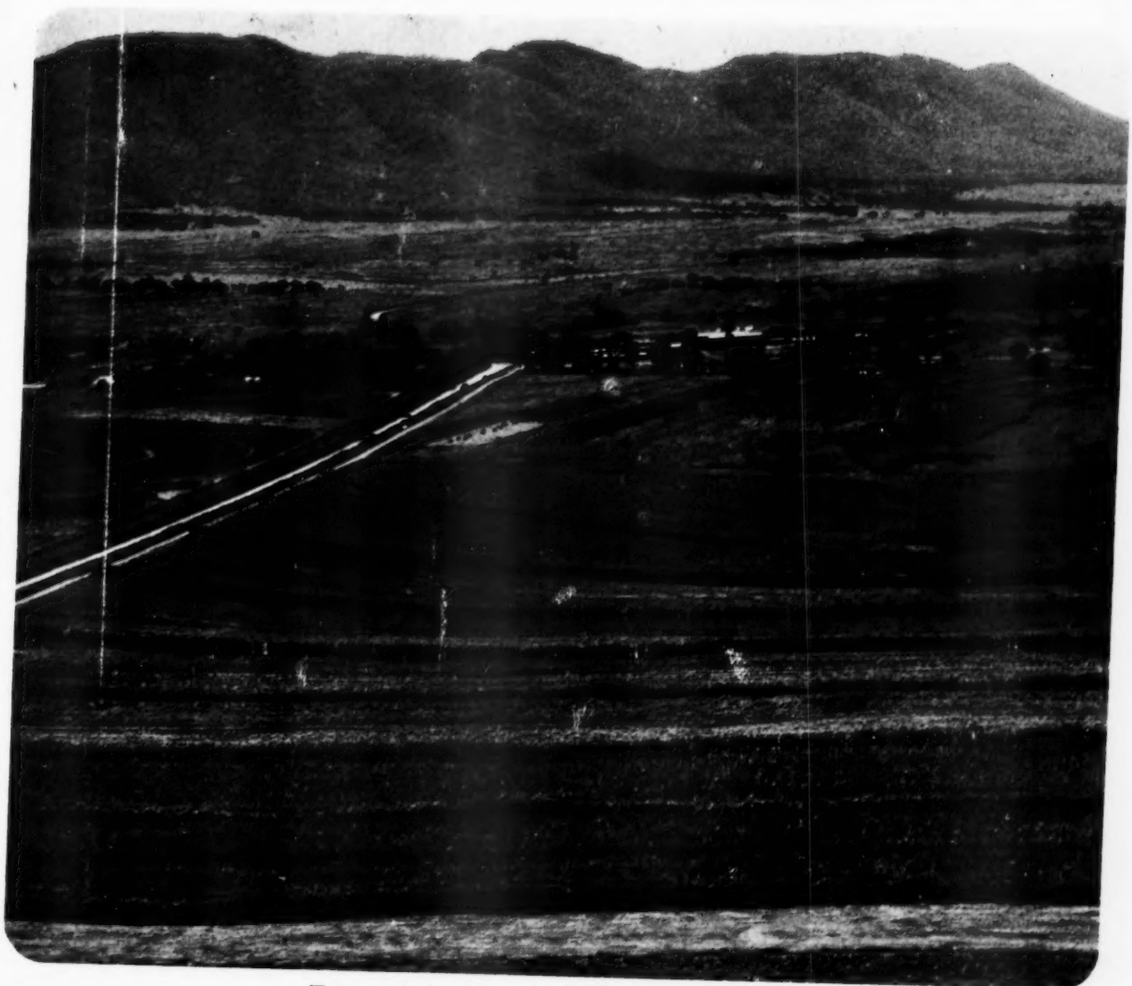

Terrace Strip Cropping in Southern Rhodesia

VOLUME 5, No. 10

OCTOBER 1953

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WORLD CROPS

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Vol. 5 No. 10 OCTOBER 1953

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Our Cover

This striking picture shows terrace strip cropping in Southern Rhodesia. (Photo: Rhodesian Air Views, Salisbury.)

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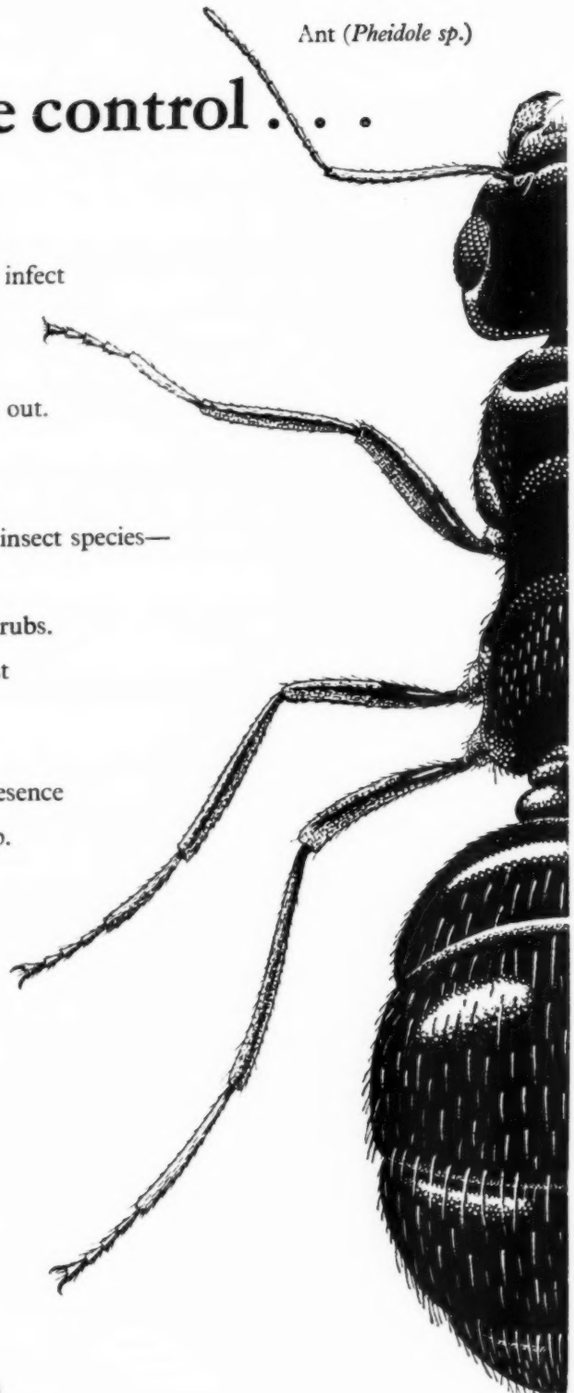

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Editorial Comment

Swollen shoot of cocoa in the Gold Coast

THE forthcoming international cocoa conference, sponsored by the Cocoa, Chocolate and Confectionery Manufacturers' Alliance, due to be held in London in September, will provide an opportunity for the further review of the world cocoa supply position, which although it shows improvement in certain aspects, is still by no means in a position which can be described as reassuring.

It appears that in West Africa, the area of largest cocoa production which is still seriously threatened with swollen shoot disease, the situation shows some improvement. Since the latter part of last year, compulsory cutting has been accepted by the Gold Coast Government as the only effective method of control of the complex of virus diseases known as swollen shoot, and the cutting out campaign has been restarted with a minimum of opposition throughout the cocoa areas in the Gold Coast and Ashanti. There has, it is true, been still a certain amount of sporadic opposition from farmers in isolated areas, but apparently it is only occasional, and the general impression gained is that the campaign is now progressing smoothly and efficiently.

It is reported, for example, that in Ashanti the disease is now completely under control and that none of the outbreaks which have not yet been completely eliminated constitutes a major danger to the cocoa industry. On the other hand, during the last period of stoppage of cutting out which lasted for 18 months, the disease got completely out of control, especially in the Eastern Province with serious spread in the north-west part of the area which constitutes a threat to Ashanti.

The disease is not yet under control also in the extreme western part of the Western Province, where it has not previously been seriously tackled and workers had, so to say, to start from scratch. It is expected that the establishment of control in this region will be a slow and difficult matter as there are many scattered outbreaks and the local tribes are not very active nor co-operative.

Reinspection and retreatment of previously treated areas which are an essential feature of the campaign have also been instituted on a satisfactory scale, while replanting of damaged areas is progressing. It is apparent that as the result of the new campaign the outlook for the Gold Coast industry has improved, and it is certainly a tribute to the Gold Coast administration that this improvement has been secured. On the other hand, the position remains serious and there seems no room for anything but the most tempered optimism.

The hopes that were entertained that a solution for the problem had been found in the new systemic insecticide Hannane, which would control the disease by poisoning the mealy bug vector, appear not to have fully materialised as yet. Apparently, there may be some risk that cocoa and chocolate made from trees treated in this way develop an unpalatable flavour. If this is correct further work seems to be needed; the method itself is so ingenious and appears so promising that its abandonment without further effort to eliminate any objectionable features which may appear is unthinkable.

Other threats to West African Cocoa

SWOLLEN shoot disease is rightly regarded as the major enemy of cocoa in the West African setting, and there is little doubt that if it is not controlled it must eliminate cocoa cultivation in this region; on the other hand, the urgency and the spectacular nature of this problem have rather served to distract attention from other aspects of the cocoa disease question in this region, which in reality possess almost equal importance. Chief among these must be numbered capsid bugs which attack the trees and the crop, and black pod, or Phytophthora pod rot, which is responsible for the loss of a large part of the crop after it has actually been set on the trees.

Several capsid bugs attack cocoa in West Africa, but two, *Sahlbergella singularis* and *Distantiella theobroma*, are responsible for the majority of the damage; they directly damage trees by attacking them and sucking the juices, they inject a toxin into the parts which they attack causing local lesions, and they act as a vector for a fungoid disease, *Calonectria rigidiscula*, which may cause extensive damage, including death of large parts of trees attacked or even the loss of whole trees. Black pod is universal in its incidence. Neither disease is responsible for so great a threat to the existence of the industry as swollen shoot, but in so far as concerns the annual toll which they take of the cocoa crop the damage they do, especially when taken together, is probably considerably greater than the actual annual loss of crop at present occasioned from swollen shoot.

Estimates of the losses caused by these two scourges are difficult to make, but one authority has suggested that it may amount to as much as 60,000 to 80,000 tons of made cocoa per annum from capsids and 30,000 to 40,000 tons from black pod, or in sum total 90,000 to 120,000 tons of cocoa in the year; in other words, more than half the cocoa crop of the Gold Coast. The same factors are also at work in Nigeria, where losses on a similar scale also occur.

Means of effectively controlling one of the two capsids (*Distantiella*) which attacks young trees in the Gold Coast have been devised, while dusting with BHC has been reported to have given good results in the Belgian Congo on *Sahlbergella* attacking mature cocoa. Black pod can also be controlled by rigorous attention to the sanitation of cocoa orchards. No doubt control is beset with difficulties, but it seems at least questionable whether if the same amount of energy and expenditure was devoted to the control of these two diseases as is at present being given to the control of swollen shoot, the gain by the way of increased crop might not be equally rewarding.

Witches' broom disease of cocoa

ELSEWHERE in this issue we reproduce a review and excerpts from a publication recently issued by H.M. Stationery Office on witches' broom disease of cocoa in the West Indies and South America. This malady has had an effect on cocoa growing in the Western Hemisphere analogous to that which swollen shoot has exercised in Africa; it has devastated cocoa in Trinidad and some other West Indian islands, has made its cultivation impossible in British Guiana and Dutch Guiana, and severely restricted production in Ecuador, Venezuela and some other South American countries.

If it by any unhappy chance was introduced into West Africa in addition to the maladies already endemic there the effect might well be disastrous. Efforts are also in progress to stimulate the cultivation of cocoa in other countries such as Malaya and some of the territories in the South Seas; if witches' broom or swollen shoot disease was introduced into these countries it might well discount in advance efforts to encourage cocoa growing. On this account it is therefore all to the good that knowledge of the symptoms and characteristics of killing diseases of this nature should be made widely known, so that should they unhappily appear in new environments they may stand a chance of being immediately recognised, thereby facilitating the imposition of measures to keep them in check.

The Wheat Agreement

AT the beginning of August the new International Wheat Agreement came into being, to which Great Britain however, as previously forseen, was not a signatory. The refusal of Great Britain to participate, of course, creates a situation which differs greatly from that which previously obtained. Under the old agreement Britain was the largest importer of wheat. Her withdrawal from the agreement reduces export quotas for adhering countries by something like 4.8 million tons. So far as Britain is concerned, trading in wheat returns to something like the pre-war pattern, and by September this had actually taken place. Private buying of wheat and grains have in fact been legally permissible in England since May last, but no wheat has yet been brought into England under these arrangements and the Ministry of Food has continued bulk buying under the old agreement which has just ended.

Elsewhere in the world the new agreement is bound to create new conditions, since the distribution of the quota formerly allotted to England has to be arranged for among the remainder of the adherents. Actually, the present position is that whereas free wheat and quota wheat were, under the old agreement, approximately in the ratio of two-thirds quota wheat to one-third free wheat, the position under the new agreement is now readjusted so that free supplies and quota supplies approximately are equally balanced.

The position is largely bound up with the production position in the United States, which is this year faced with a record crop of wheat. Recent figures show that the total supply of wheat in the U.S.A. is 1,717 million bushels, which includes a carryover from last season of 580 million bushels and a crop of 1,182 million bushels. The normal wheat supply figure is 1,156 million bushels, so that the total amount of wheat available this year exceeds the normal amount by 48%.

The present position and outlook

ELSEWHERE, too, wheat is plentiful: Canada expects another very large wheat crop, a recent official estimate is for 604 million bushels. The record crop was 688 million bushels last year. In India, also, there is no longer any shortage of wheat, owing to two good harvests running. It is not surprising in the circumstances that sales under the new wheat agreement are reported to have been slow, notwithstanding that prices have dropped substantially.

It is not, indeed, surprising that the position is causing some anxiety in the U.S.A. Mr. E. T. Benson, U.S. Secretary for Agriculture, announced a referendum among wheat producers on the question of wheat quotas. The referendum showed overwhelming support for the maintenance of strict federal controls in return for high Government price supports, the desire being to ensure that despite heavy world production, prices to farmers in the U.S.A. are maintained at levels comparable with those previously current. In the new wheat agreement the price of $2.05 per bushel which Britain refused to accept was, it is understood, adopted on the instance of the U.S.A. with this object in view. Looked at dispassionately it would seem that the decision of Britain is abundantly justified, and however much one may sympathise with the desire of farmers to receive remunerative prices for their crops, to the ordinary observer it is permissible to wonder whether attempts to keep prices up in the face of world surpluses of production in this way can achieve success as a permanent type of relief measure.

Drought in the Southern U.S.A.

WHILE Great Britain and a large part of Europe are experiencing a summer which is noteworthy as one of the wetter kind, in the U.S.A. on the other hand sunshine has been more prevalent while in some areas serious conditions of drought are reported. The regions most severely affected apparently are sections of Texas, New Mexico, Colorado, Oklahoma, Kansas and Arkansas, where drought conditions are reported to have prevailed during the past four years culminating with the present season when conditions approaching a disaster are apparently feared. Throughout the regions of the South West farmers normally expect dry conditions in the later summer, but this year the dry spell has taken a firm hold much earlier than usual and has resulted in farmers and ranchers being caught in a squeeze between falling market prices for livestock and farm produce and conditions unfavourable to agricultural production and stockraising. As a result, large numbers of cattle have been moved from the ranch to the market and prices have sunk even lower in consequence. Another

result has been that water holes have tended to dry up leading to concentration of stock round those which remain and consequent overgrazing and increased erosion.

In consequence, President Eisenhower has designated portions of the six States as disaster areas thereby making them eligible for federal aid; the measures proposed at present will provide for supplies of feeding stuffs through out the area at prices 40% to 50% below the market cost, enable railways to grant lower rates for the transport of cattle to other feeding areas and on foodstuffs moving into the areas and provide for extended credits to farmers.

Longer term plans for mitigating the situation and providing against a recurrence of similar conditions in the future include making increased use of available water supplies in the region for irrigation and for supplying water for stock, including both the harnessing of flow of certain of the States' rivers which at present run wasted into the Gulf of Mexico, and exploiting the underground water supplies by wells and boreholes.

Difficulties of this type are inevitable from time to time in tropical to subtropical regions of low to medium rainfall where the type of agriculture prevailing is a combination of ranching and cultivation of suitable annual crops. It is in fact a repetition of what commonly occurs in areas in East and South Africa, parts of Australia and in South America. It remains to be seen whether the U.S.A. with her immensely great federal resources can make the notable contribution to the solution of this world wide problem which its nature within her own borders demands.

Britain v. the Colorado beetle

THE continued success of Britain's defence against the Colorado beetle is too easily taken for granted. On opposite coasts of Europe, separated at one point by as little as 20 miles of sea, the beetle is established and breeds prolifically. Imported vegetable produce brings beetles into the country; they arrive, too, as minute stowaways on ships and aircraft. But vigilance and the routine spraying of potato crops in the most geographically vulnerable areas is preventing successful invasion each year. In 1952, there were 112 reported and confirmed visitations; this compares with 83 in 1951 and 170 in 1950. About half of these invasions occur in March and early April and result from the carriage of beetles in imported vegetables, mainly lettuce. Legislation bans these imports at the end of March. The fact that beetles still continue to be found during the first weeks of April is merely a carryover from late March importation. The next major phase occurs in July when the beetles arrive as ship passengers. Perhaps a good many more beetles journey into England than the number officially reported; but if so, we must assume that they perish as a result of the spraying campaign, for in 1952 only two breeding colonies were found, one in some Kent allotments and the other in a Surrey garden. In the former case 35 beetles and over 2,000 eggs were found on nine allotments, so the speedy recognition of this 'incident' was of vital importance to the whole campaign.

An unusual find of beetles last year was the discovery of 19 in a parachute factory. The parachutes concerned had been sent to the factory for cleaning and repacking after use by the Territorial Army in Germany and they had been dropped in a German potato field during military exercises. One factor to be borne in mind for the future is that in Europe the beetle is steadily expanding its southward hold. As this southern movement goes on, beetles will emerge from hibernation earlier and the risk of beetles entering Britain in imported produce will not remain as small as it is now in January and February. It may well become necessary to start the ban upon imported vegetables earlier than at the end of March. The Colorado beetle is learning an old lesson —the small island of Britain is most difficult to invade.

Queries from Rothamsted

PRELIMINARY tests reported from Rothamsted for two new and quite different kinds of soil additives—nitro-phosphatic fertilisers and synthetic soil conditioners—seem to raise significant queries. Nitro-phosphates can be produced by several processes and three of these products were tested for grass cut as hay or silage. One gave better yields than a treatment based on equivalent nitrogen and phosphate in the form of superphosphate. Another was only two-thirds as effective, and the third was so inferior that the response was almost insignificant. But it is possible that the differences in methods of production were not as influential as the differences in granular condition. The phosphate content of these new fertilisers tends to be citrate-soluble rather than water-soluble; where the superphosphate process yields a mono-calcium phosphate these other processes for treating phosphate rock produce more of the di-calcium phosphate. But owing to the hygroscopic nature of these products, caused mainly by their association with nitrate, they must be granulated to be given a suitable physical condition for handling, storage, and drilling. The question that now seems to be emerging is whether *in the soil* a granular presentation of slowly soluble phosphate is likely to be consistently efficient. Water-soluble phosphate can pass readily out of a granule. Is the same device desirable for phosphate that is not dissolved by soil moisture as speedily? Certainly it seems that much more attention must be paid to granular type—to size and hardness, for example.

As for synthetic soil conditioners, a hydrolysed polyacrylonitrile, without filler or diluent, was tested on 13 farms and in three forest nursery experiments. On the farm plots no significant increases in yields (potatoes) were obtained, and 'repeated inspections during the season' showed no differences in soil structure, though at two farms there seemed to be better soil structure at lifting-time. Similarly, negative results emerged from the forest nursery tests. It is suggested that the hygroscopic nature of the conditioner tested may have limited its incorporation with the soil; if so, better-conditioned conditioners must be produced before they can hope to benefit farmers or growers. It is too early to form settled conclusions, adverse or favourable, about such new substances as synthetic conditioners. But yet once more it seems clear that a scientific idea must pass through long stages of development before it can fit the practical needs of agriculture.

Potash developments

THE formation of an International Potash Institute, headquartered at Berne and closely associated with French and Western German producers, will receive general approval from agricultural scientists. The Institute, under joint French and German direction, will function as a centre for collecting and issuing technical information about potassium as a crop nutrient. Although well established as a major nutrient, the use of potash is under-developed in many countries, and a wider appreciation of its functions must undoubtedly help to increase world food production. The sources of potash are large, and of all fertilisers it is certainly the cheapest concentrated source of a single plant-food. The existing market for potash in countries where its use is already well established seems to have reached a stage when expansion in demand is smaller than potential expansion of production. Shorter working hours have recently been introduced in some of the French mines; sales declined sharply in 1951, and earlier post-war plans to increase output have had to be modified. The Palestine potash industry, brought to cessation by the war in Israel, is soon to be reopened. There has not been much news recently about progress in developing the huge but deep-lying potash deposits in Yorkshire, but a British potash industry can hardly be disregarded as a possible event of the future. Potash, once an entirely German monopoly, is rapidly becoming by far the most plentiful fertiliser material. Its prospects as the basis of a healthy industry increasingly depend upon expansion in use.

Cotton and cottonseed in India

INDIA produces more than 1.2 million tons of cottonseed per annum, but so far little of this crop—certainly not more than 5%—has been processed for oil extraction. The reason for this neglect is that crude cottonseed oil is very dark and difficult to refine compared with other edible oils such as groundnut or coconut oil. Now the National Chemical Laboratory at Poona has developed a relatively simple process for refining and decolourising the crude oil. Cottonseed oil when extracted has a high acid value; initial treatment with alkali in slight excess is therefore necessary. Hot water washing and then heating the separated oil to remove moisture is followed with decolourising agent treatment. Activated carbons or absorptive earths may be used. Exposure to sunlight after this stage for about 20 hours lightens the oil's colour even more. A further treatment at a high speed of agitation with relatively small amounts of alkali solution removes more colour still. It is possible that the adoption of this process by India's edible oil industry could greatly increase the nutritional yield of the cottonseed crop.

Another development, also from Poona but from the School of Agriculture there, may affect cotton. Partition of the sub-continent brought a sudden shortage of jute, and in the search for substitutes a suitable fibre was found to be extractable from the bark of cotton plant stalks. The quality of this bast fibre varies with the variety of cotton plant—in some cases (*Virnar* and *Jarilla*) the fibre closely approaches jute fibre, but the fibre from others can only be used in mixtures with real jute fibre. At present, cotton stalks are disposed of by burning as fuel. The fibre can be extracted by the same type of processes as those used for jute fibre extraction, and the plant residues could still be used as fuel. There are several million acres in India devoted to cotton, most of it raised as a dry crop rather than by irrigation. The dry acreage is likely to give high yields of this coarse stalk fibre. Its commercial development could add to the cotton grower's income and add to India's supply of rope-making and sack-making fibres, a supply that is certainly inadequate since partition.

Freedom for fertilisers

ANOTHER control in Britain has disappeared. For the first time for 14 years fertilisers are free from price control legislation. A long period of annual statutory orders has come to a natural close—natural because sufficient competition now exists to ensure that prices find their lowest level from the normal interplay of market influences. In the peak of the spring demand will no doubt continue to exceed supply; but in the rest of the year these two principal market factors will be in easy equilibrium. No farmer need fear that he will suffer through the absence of price control regulations. Indeed, one of the first effects is that many fertiliser prices have been reduced. Some of the price-building factors in fertiliser manufacture and distribution are falling today and it is much easier for a 'free' industry to pass on such benefits without delay. Variations between prices from different manufacturers are unlikely. The fertiliser industry still looks back with anguish upon periods between the wars when minor differences in surcharges, station prices, or collection allowances unsettled market conditions. For technological progress stable and predictable economic conditions are a primary need; nothing is less likely than a sudden price war between manufacturers who for almost a decade and a half have been co-operating with each other and with the Government to ensure that the controlled industry has operated effectively.

It is a legacy from the hard and depressed days that farmers attach so much importance to fertiliser prices. Quality, plant food content, service—these are surely more significant factors than small differences of a shilling or two per ton. The wise buyer will seek a fertiliser with the analysis he wants—and certainly among the compounds there are many variations—and not consider the question of price until he has found which manufacturers or merchants can supply it. He will find a high degree of uniformity in quotations, for all manufacturers are facing much the same costs of production, bagging, and distribution. He will no doubt find, too, that early delivery rebates are available for most fertilisers, as was the case during the years of control. The surest way for farmers to get cheaper fertilisers is to spread their orders over the year or at least to reduce the excessively high peak of demand in March. Coping with this peak inevitably increases works costs and it is the consumer who pays in the end.

Prospects for Cocoa in the South Pacific

In West Africa and in South America and the Caribbean the threat to cocoa from disease has stimulated interest in the possibilities and prospects for establishing cocoa cultivation in other parts of the tropics. In this connection, Mr. D. H. Urquhart, formerly Director of Agriculture in the Gold Coast in 1951 and 1952, visited the islands of the Western Pacific on behalf of Messrs. Cadbury and also of the South Pacific Commission to examine the position. The following account is summarised from his reports.

THE South Pacific Islands range in size from the large land masses which constitute Australia and New Guinea to small atolls. They are mostly subject to heavy rainfall and have a warm humid climate. Soils vary from those derived from rocks which are old, in the geological sense, to recent volcanic deposits and soils accumulated over recent coral formations. The populations are unevenly distributed. There are areas with many square miles of territory with few people and there are islands where the pressure of population is so high that there is insufficient land for their support. The peoples, who are made up of Melanesians, Polynesians and some immigrant Indians, are mainly backward, according to European standards. The mode of life of the bulk of the Melanesians is still primitive.

The islands already supply a great deal of copra and sugar, some cocoa and other tropical crops. Greater and more widespread agricultural development of the territories would lead to greater prosperity and advancement of the indigenous peoples and a better supply of tropical products for world markets. Strategically, the development of the territories is of great importance.

The plantation industry

The products of the coconut palm provide the main export. Indeed, the economy and prosperity of most of the islands is dependent on exports of copra. Cocoa is of importance in Western Samoa and coffee in New Caledonia. There is a large sugar-cane industry in Fiji. Several islands export bananas and some citrus. There are some rubber plantations here and there, the main production being in Papua.

The main limitation to expansion is lack of population and its uneven distribution. For example, if a great proportion of the population of Australian New Guinea were living in parts of the territory where they could produce cash crops for export in addition to their subsistence farming, the exports from that country could be increased many times. Similarly, if the natives of the New Hebrides came to farm on the more fertile lowlands, production in the island group could be stepped up far above its present level.

A great proportion of the present plantation industry was built up with indentured labour imported from Asia and Indonesia. Future development of European enterprise by the use of native labour will be limited, as supplies of indentured labour cannot be visualised, and there is also the difficulty of getting sufficient labour, combined with the high cost of transporting it to and from the plantations.

Mechanisation has been applied in a minor degree to plantation operations. There is little doubt that the greatest hope for private enterprise in the plantation industry in the future lies with the maximum use of mechanisation. Expansion of production will not be limited by lack of land. While there are vast areas of land of low fertility, there are still great areas of good fertile land as yet untouched.

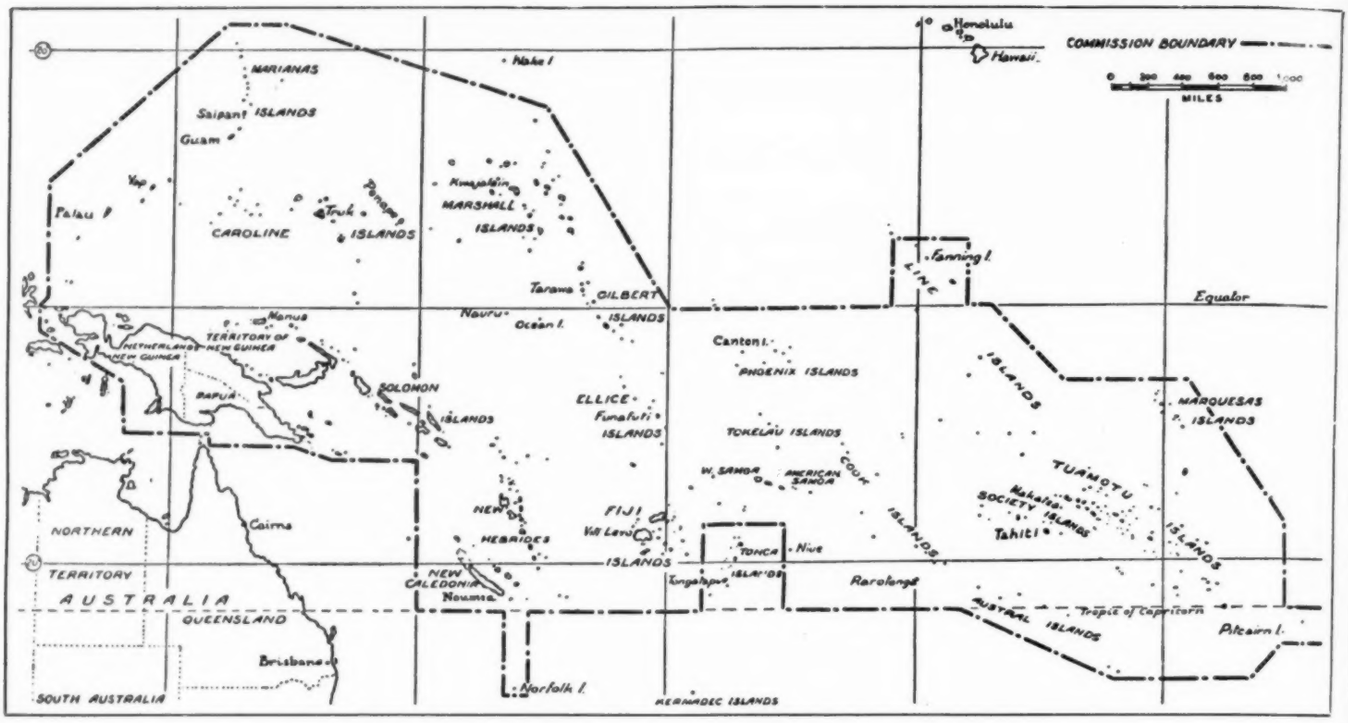
In some cases, private enterprise in the form of plantation companies or individual planters must predominate; in other cases, indigenous races will play an increasing part in providing exports, and in still other cases there will be the enterprise of the indigenous people and private enterprise working side by side.

Need for research

The South Pacific Islands are probably the only part of the world today where there is no well organised research institute or body catering for the needs of agriculture. The only specialist skill employed in the Pacific to study the needs of crops is the specialist staff of the Department of Agriculture in Fiji, who are concerned almost exclusively with Fiji, one or two specialists in Australian New Guinea, and the staff of the recently established research institute in Noumea.

Anyone with an intimate knowledge of plantation conditions in the Pacific will agree that this need for research is extremely urgent. Research is needed so that established plantations may be maintained in economic production and so that information may be provided which will enable future plantations to be made on lines which would ensure profitable returns.

Young cocoa plantation at Keravat with *Leucaena glauca* as shade



This map shows the area of the South Pacific Commission

Territories visited

The territories visited in the course of two tours extending over two years included Australian New Guinea, Netherlands New Guinea, the British Solomon Islands, New Caledonia, the New Hebrides, Western and American Samoa, the Cook Islands, and Fiji. The main conclusions in regard to each of these are summarised below.

Papua (Australian New Guinea)

New Guinea is, after Greenland and Australia, the largest island in the world. It is divided into Australian New Guinea or Papua, which includes the former German New Guinea, and Netherlands New Guinea. Its total area is 330,000 square miles, while that of Papua is 80,000 square miles, including the adjoining islands of New Britain, New Ireland and Bougainville. It is administered by the Australian External Territories Department. The centre and north of the territory are mountainous, with elevated plateaux still only partially explored; in the south there is a broad low-lying plain. The climate is hot and humid, rainfall ranging from 72 to 142 in. Soils are derived either from recent volcanic rock or sedimentary rocks. Conditions are suitable for cocoa production, and there are large tracts of land with soils well adapted to the requirements of the crop.

The main plantation crop is coconuts. Cocoa was introduced prior to the First World War; at first little interest was shown, but before the Second World War interest extended and by 1941 potential production was estimated to be 1,000 tons. During the Japanese invasion much of the cocoa was destroyed, but interest is now reviving in both as a plantation and as a peasant crop. Some excellent planting material exists, and yields up to 7 lb. per tree have been recorded. New Guinea could well become a major cocoa-producing country. An interesting point that has been demonstrated is that cocoa can be grown interplanted with coconuts.

The cocoa industry at present is in the hands of individual planters, some large firms and a limited number of small native planters. The speeding up of production on a large scale is likely to depend on large commercial enterprises willing to invest the necessary capital; here one of the difficulties is shortage of labour. It has been estimated that the total potential labour force available is 300,000, of which about 35% live on or near potential cocoa land. Consequently, developments seem to depend on making the maximum use of modern labour-saving equipment in establishing plantations. It seems not unlikely that native production will expand, but the rate is likely to be slow.

Netherlands New Guinea

Netherlands New Guinea is the western portion of the sub-continent of New Guinea. The area is approximately 150,000 square miles. It extends from the Equator to 9° S. and lies between 130° E. and 141° E. longitude. The native population is estimated to be about 1 million, of whom 300,000 are under administration. The remainder live in forests and in mountainous country where contact is very difficult. There are 8,500 Europeans and 2,500 Asiatics.

Despite the fact that steep mountain ranges and extensive swamps occupy great areas, there is no doubt that further exploration will reveal large areas suitable for agricultural development. The natives are primitive and the majority have not emerged from the Stone Age. The primeval forest and the lack of roads and navigable rivers are factors which have contributed towards keeping the native in his primitive state. The timber resources are considerable, but the main industry, up to the present time, is the exploitation of petroleum. The prospects for iron, cobalt, nickel and chromium are being investigated.

In general, the climate is wet with high humidity. The temperatures at low levels are fairly high without great variation throughout the year. Rainfall is adequate for any tropical crop. As the climate everywhere in the lowlands, excluding Merauke, is suitable, cocoa can be grown where the soils are suitable.

There is a small amount of cocoa already growing, mainly hybrid Forastero-Criollo, and a few young trees of Amelonado which originated from seed introduced from the Gold Coast. Some of the trees bear beans

of good size and shape. Samples of fermented beans were sent to manufacturers in Holland, but as the quantities available for fermentation were very small, it was impossible to prepare well-fermented supplies for the manufacturers' report. It can be confidently assumed that a good proportion of the material is basically good. There was no evidence of disease in the trees seen near Hollandia and in the region of the upper reaches of the Grime and Sermo Rivers.

The Solomon Islands

This is a British Protectorate lying to the east of New Guinea between latitudes 5° and 10° S. They comprise ten main islands, of which the largest are Guadalcanal and Malaita. The total area is roughly 12,000 square miles, and the total population about 95,000; 40% of the population is concentrated on the island of Malaita. Coconuts are the only crop grown on a plantation scale. The native population is predominantly occupied with crude subsistence farming, and labour is short.

The climate is hot and humid, and rainfall is high. The soils vary from a stiff clay to moderately open easily worked types. A few cocoa trees are growing on the main islands and conditions appear to be well suited for cocoa growing, and there are probably very considerable areas where cocoa could be grown successfully.

One of the main difficulties, as in New Guinea, is shortage of labour, and if cocoa growing is to be established on a plantation scale it would probably be, as in New Guinea, by the intervention of large-scale commercial enterprise and the use of mechanical aids so far as possible.

At the same time, if cocoa could be integrated into the present system of native subsistence farming, and the experiment proved successful, it should greatly help in lifting the average level of native existence.

New Caledonia

The island of New Caledonia is a French Colony lying between 20° and 23° S. latitude and 164° and 166° E. longitude. Its area is 6,200 square miles, of which 247,000 acres are cultivable and 50,000 acres are cultivated. The total population was in 1946 estimated to be 61,000.

The island is mountainous, especially in the east, although there are areas of flat land. Climate is tropical but equable, temperatures rarely exceeding 90° F. or falling below 60° F. Rainfall is variable, according to locality, ranging from 40 to 118 in., and humidity averages 75%. Droughts occur occasionally and the island is subject to periodic visitation by cyclones.

The principal crops grown, apart from annual food crops, are coconuts and coffee. Cocoa apparently is not cultivated, but as conditions are apparently fairly well suited to coffee growing, it may be supposed they would be suitable for cocoa also.

The New Hebrides

The New Hebrides are administered as a condominium shared between Britain and France. They consist of numerous islands and islets. The group lies between 13° and 21° S. latitude and 166° and 171° E. longitude. The estimated area is roughly 5,700 square miles.

The three largest are Espiritu Santo, Malekula and Erromanga, with a total area of 2,300 square miles. They present a mixture of sedimentary rocks and volcanic intrusions. On three of the islands there are active volcanoes.

The population is estimated to be 45,000. It is composed mainly of Melanesians with some Polynesians. Populations have dwindled considerably of late years.

Coconuts, cocoa and coffee were important crops in the past. When indentured labour was no longer available, coffee plantations were neglected and later all but a few cocoa plantations were abandoned. Even in times of good prices for copra, quite a number of coconut plantations have been neglected, owing to labour difficulties.

The climate is suitable for cocoa. There are a number of plantations on Santo and Efate where cocoa trees are growing well in plantations sited on suitable soil. Where the trees have been planted under unsuitable soil conditions, evidence of lack of soil nutrients can be seen in the cocoa leaves, however.

Cocoa tree—Lafi 7, unaffected by Phytophthora, black pod disease

There are extensive areas of good soil on both Santo and Efate suitable for cocoa. The possibilities for extensive growing of cocoa on these two islands, especially Santo, are extremely promising. There appears to be some very good cocoa material in some of the plantations. Selection of the best cocoa trees available should provide suitable material for vegetative propagation to supply plantation needs.

Native farming follows the pattern of primitive native farming in many tropical countries. The forest or bush is cut, burned and farmed, and the farmer moves on to new land. Given suitable soil conditions, the easiest way, possibly, to encourage native communities to plant permanent crops would be to get them to interplant these through their annual crops. This method of establishing permanent crops has been practised successfully in other parts of the world.

Many European plantations have been abandoned for lack of labour. The order of abandonment has been coffee first, then cocoa; and many coconut plantations are much neglected or abandoned for lack of labour. The question is how to restore and expand the plantation industry. The natives in their present state of development will not come to work on European plantations in sufficient numbers to enable the European plantation industry to be expanded or even maintained at its present level. The only alternative is to bring the plantation industry to the native. The native has already shown a considerable adaptability in planting coconuts. He now produces the bulk of copra exported, apart from what he consumes for his own seeds.

What is urgently required is a well-prepared plan to develop the native as a producer of export crops. This would have the dual value of lifting the native out of his present primitive and backward condition and developing the country as a whole.

Western Samoa

Western Samoa is administered under mandate by the Island Territories Department of New Zealand. It lies between latitudes 13° and 15° S. and longitudes 171° and 173° W. It comprises two large islands, Savai'i and Upolu, and a number of small ones. The total area is 1,130

square miles, of which 700 are in Savai'i and 400 in Upolu. The islands are mainly volcanic in origin and there are high mountain ranges in both main islands. Samoa is still an area of active volcanism.

The climate is tropical, with heavy precipitation and occasional severe storms. The wettest months are from December to March. But the rainfall throughout the remainder of the year is considerable. The difference in mean temperatures between the hottest and the coolest months is only a few degrees.

The agriculture practised by Samoans is mainly confined to 'gardens' or areas within the family compound, and in some cases to farms in forest areas. The mainstay of the Samoan diet is taro. Coconuts have always been grown and have been the most valuable single export crop. There is a lack of reliable records of the early history of cocoa, but it would appear that the first plantings took place towards 1900. The export of cocoa began early in this century, and it may soon exceed coconut products in value as an export crop.

By 1910, exports were just short of 500 tons; the average annual export for the period 1911 to 1930 was still under 1,000 tons, but, during the period 1941-50, the average annual export had risen to 1,857 tons. The average of each two-year period during the past six years give a picture of the steady increase of output over that period when the figures were as follows:

1946-47	.. ..	2,131 tons
1948-49	.. ..	2,262 ,,
1950-51	.. ..	2,546 ,,

Planting of cocoa was made on estates in the early stages, but a good many years elapsed before Samoans planted cocoa. Of recent years Samoans have planted many trees and the bulk of the cocoa exported is now produced in compounds and in a few large plantations owned by Samoans. The planting of cocoa in compounds does not usually conform to the ideal in the matter of adequate preparation of the site for planting, spacing, shading and pruning. Also, the processing of the beans for the market often leaves much to be desired.

Apart from a few European-owned estates, the largest plantations are under the management of the New Zealand Reparation Estates (usually referred to as N.Z.R.E.) a body constituted to manage ex-enemy estates after the 1914-18 war. This body controls some 1,600 acres of cocoa and the area is being increased by new planting; it also manages coconut and rubber plantations.

Compared with many other parts of the world, pests and diseases are less prevalent

One of the cocoa trees at Keravat selected before the war, from which cocoa is now being grown

in Western Samoa than in most parts where cocoa is grown on a large scale. The Rose beetle (*Adoretus* spp.) attacks the leaves of the young cocoa seedlings and does a great deal of damage. *Phytophthora palmivora* destroys a considerable part of the crop at certain times of the year. It also gives rise to 'canker' where the trees have been unskilfully handled.

The quality of cocoa exported is strictly controlled by produce regulations operated under the supervision of the Department of Agriculture. The estates prepare their beans very efficiently before sending to the port. The cocoa produced by the Samoan small farmer has usually to undergo a great deal of reconditioning by washing, picking, drying and grading at the port before it can be exported.

Mature cocoa and coconuts in the same plantation

Western Samoa has by far the largest and most important cocoa industry in the Pacific, and it has maintained a steady increase over the last 50 years. If the steady increase in output indicated by the export figures over the last six years is maintained in the future, cocoa will soon become the country's main source of income, taking the place of copra, which has been the main export over the last century.

American Samoa

The group of Samoan islands administered by America lie east of 170° W. longitude and about 14° S. latitude. The area of the five main islands is about 76 square miles. The population is 19,300, of which approximately 83% are concentrated on Tutuila Island. There has been a steady and rapid increase of population since 1900.

The rainfall is high with an annual precipitation of over 162 in. on Tafuna and over 190 in. on Tutuila. It is well distributed throughout the year. Temperatures vary from 75° F. in August to 90° F. in December. Humidity is high.

The soils on hillsides are extremely variable in fertility. Shifting cultivation is normal, but, with a rapidly increasing population, the length of the fallowing period between crops must be shortened. Coconuts and breadfruit are the main permanent food crops and taro the main annual crop. Bananas are important; papaya, oranges and limes are grown.

The territory is faced with some acute problems. These include:

(1) Rapid population growth.
(2) High incidence of pests and diseases of crops.
(3) High incidence of erosion, aggravated by steepness of the land, the heavy rainfall, and the overdense population.
(4) Lack of cash crops, timber and minerals.

There are a number of young cocoa plantations along the hill slopes and one on flat land at low level. Some plantations were recently planted, others are just coming into bearing. The growth of the cocoa trees in general was good. There were indications from leaf effects in a number of the plantations that soil nutrients were insufficient or unbalanced. One of the most promising plantations which is just coming into bearing was heavily attacked by mealybug. This could no doubt be brought under control.

If suitable land is carefully selected, cocoa could be grown. While the areas

Typical Polynesian houses in Western Samoa

will not be extensive, the contribution to exports would be useful.

As Western Samoa proposes to select and multiply its best material, supplies of high-grade cocoa planting material could be secured from there.

The Cook Islands

The Cook Islands are a dependency of New Zealand administered by the Department of Island Territories. They comprise 15 small islands scattered over an area of some 850,000 miles of ocean, between latitudes 9° and 23° S., and two other groups of small islands of which only some are permanently inhabited.

The total land area is roughly 100 square miles, and the total population is about 16,000. The climate is mild and equable; mean temperatures are around 75° F. and rainfall is from 70 to 90 in. Except in the northern group rainfall is very variable and droughts frequent. The islands lie in the hurricane belt and hurricanes occur frequently.

The fruit industry is the most important economic factor in the lives of the people and has an important bearing on their progress generally.

The exports of these islands are agricultural produce and mother-of-pearl shell. Shortage of shipping limits progress and is a hindrance to the development of the most important industry, namely, fruit growing.

The climate is marginal for cocoa. There are a few cocoa trees growing in Rarotonga. Apart from the fact that there are leaf conditions which indicate the absence or excess of certain elements in the soil, the trees look well-grown and healthy. Cocoa could be grown in the valleys provided they were well sheltered.

The Fiji Islands

The Fiji Islands are a dependency of Great Britain. The colony is composed of about 250 islands, of which some 80 are inhabited, lying between latitudes 15° and 22° S.; the 180th meridian passes through the group. The total area is 7,056 square miles, including Viti Levu (4,011 square miles, nearly the same size as Jamaica), Vanua Levu (2,137 square miles), Taveuni (166 square miles) and Kadavu (165 square miles). The main islands are volcanic in origin. Both main islands are crossed by mountain ranges extending roughly from south-west to north-east, but there are also a number of secondary ranges and the topography generally is considerably broken.

Climatically, the two main islands have distinct wet and dry zones, the south-east and north-west respectively. The rainfall at Suva (the capital, situated in south-eastern Viti Levu) averages 120 in. and is higher away from the coast; in the dry zone the rainfall is variable around 75 in. with a pronounced dry period from June to September. Temperatures vary with elevation, but mean maximum and mean minimum temperatures respectively are 96° F. and 59° F. at Suva. Humidities are high, particularly in the summer. The islands lie in the hurricane belt and hurricanes occur from time to time.

The estimated population in 1951 was 302,000 people, of which 133,000 were native Fijians and 143,000 the descendants of immigrant Indians. The soils of the wet zones are red loams and red earths overlying tuffs, marls, limestones, and volcanic rocks. They vary in texture from loams to clay loams. The parent material of these soils, their immaturity and the luxuriant character of the vegetation they carry suggest a good fertility status, which has been borne out by analysis.

The principal agricultural export products are sugar, copra and bananas, normal annual exports in round figures being:

Sugar	140,000 tons
Copra (as oil or copra)	35,000 ,,
Bananas	500,000 stems

Other local products of importance to the internal economy of the colony are: cassava, yams, rice, pulses, sweet potatoes, maize, tobacco, spices, citrus and a variety of tropical fruits, including pineapples, canned and fresh, of which there is a small export. The dairy industry is important locally, and the greater part of the beef and pork requirement of the colony is home produced. Crops which have been grown successfully, but which have for various reasons not developed as major industries, include cotton (Sea Island), rubber, tea, coffee (Arabica and Liberica), vanilla, sisal hemp, and also cocoa.

Cocoa was planted towards the close of the 19th century and early in this century. It was said to have been planted in 14 different places, ten of which were in the wet zone and four in the dry. Some of these trees have survived, although all surviving trees have suffered from long periods of neglect.

Small stands of cocoa have been seen at various places along the south coast of Vanua Levu, on the west and north-east coasts of Taveuni and on the plant introduction station at Naduruloulou on Viti Levu. In all cases the vegetative growth was good; some trees were in bearing or flowering. Some showed leaf effects which suggested lack of certain soil nutrients. These effects might have been due to leaching of the soil.

The general conclusion arrived at from an inspection of the trees on the various islands is that, if the cocoa trees survived so much neglect, they would have done well under normal attention.

It is usually accepted in some circles that Fiji is unsuitable for cocoa owing to its being in the hurricane zone. This point has been carefully considered in the light of experience in other countries, and

the conclusion reached that while cocoa, in common with all other plantation crops, will suffer from hurricane damage, the losses likely to be caused are not such as to make cocoa growing uneconomic in Fiji. Coffee in New Caledonia also suffers from hurricanes in much the same way as would cocoa, but the effects of hurricanes have not deterred planters from growing coffee there.

Moreover, modern propagation techniques can produce cocoa plants in large numbers which will yield a crop in four years or earlier from the date of planting, so that trees badly damaged by hurricanes could be quickly replaced.

The conclusion is reached that climatic and soil conditions in Fiji should make it possible to establish a cocoa industry. The liability of Fiji to hurricanes does not necessarily make cocoa planting uneconomic, being given the high prices for which cocoa is selling.

Cocoa would be a suitable crop for Fijian peasant farmers and the main hope of building up a cocoa industry seems to lie with them. Plantation interests are mainly concerned with sugar, bananas, coconuts and pineapples; some estate owners, however, may consider the possibility of planting cocoa as an addition to coconuts. The possibility of planting cocoa through coconuts as practised in New Guinea seems worth considering where soil conditions are suitable. Fiji possesses efficient Government agricultural services, but these would need strengthening if a cocoa industry is to be established.

Conclusion

There appears to be abundant scope for the extension of cocoa growing in the island regions of the Pacific. Soil and climate conditions are favourable and abundant land is available. There is room for expansion both as a plantation crop and as a crop for the peasant farmer. The main difficulty is that of finding sufficient labour.

Throughout large areas there is liability to the occurrence of hurricanes, but this need not be held to rule out the possibility of growing cocoa, being given the high returns the crop can give.

South African Crop Prospects

(*From Our South African Correspondent*)

Citrus growers' difficulties

The citrus industry's decision to cut exports and retain an additional quantity of citrus for sale in the Union is costing the industry a considerable sum. In June because of short supplies due to the holidays and the end of the crop of navel oranges at two large citrus estates the Citrus Board instructed all growers to retain up to 10% of their supplies in the Union. With overseas prices favourable to the exporters of all types of citrus this instruction meant lower returns for the export producer. To provide adequate fruit for the Transvaal Cape export producers were instructed to increase their retention of citrus in spite of the fact that local markets in the Cape could not absorb all the first- and second-grade fruit available. This fruit, again at a loss to the industry, was railed to the Rand and other centres. Later in the season when the Cape navel orange crop comes to an end, it was expected that Transvaal growers would probably be asked to rail part of their crop to the Cape. In this way, through organised distribution, the industry sees that each of the Union's markets receives its fair share of available fruit with the result, however, that growers will suffer a substantial loss.

Sugar

All mills have been fully engaged in crushing the current sugar cane crop and the present indications are that a favourable season can be expected. Early deliveries of cane showed a satisfactorily high sucrose content and it is possible that the output of sugar for the season may be about 700,000 tons. Sugar production for the 1952-53 season surpassed early expectations. In view of the prolonged drought during the preceding season which had adversely affected growing cane preliminary estimates were low. Good winter rains, however, were followed by a spell of hot weather in August and September, and the weight and sucrose content of the cane improved to such an extent that production, at 670,188 short tons, was well above preliminary estimates and also the output of 535,505 short tons for the 1951-52 season.

Sales of sugar increased from 516,144 short tons for the 1951-52 season to 576,000 short tons last year, the difference between the latter figure and production being accounted for by refining losses and the quantities required for the replenishment of reserve stocks. All exports of sugar from the Union, including supplies to Southern Rhodesia, were suspended during 1952. A resumption of exports to Southern Rhodesia has, however, been arranged, and it is also hoped that production this year will be sufficient to allow shipments to Great Britain.

Maize crop

In one of the most bountiful years in South African agricultural history crops have flourished and record sums are being paid to farmers for their season's work. At the start of the season, farming areas were in the grip of a serious drought and the outlook was black. Later in the year, however, good general rains fell and the picture changed. The latest estimate of the maize crop, 32,300,000 bags, is an all-time record, as is the sum exceeding £50 million which will be paid to maize farmers.

Soya bean experiments

Extensive experiments are being carried out at the Potchefstroom College of Agriculture to find better varieties of soya beans and cowpeas. Mr. H. M. Muller, who has just completed his degrees in genetics at Stellenbosch University, is in charge of the work. He is engaged at present on 450 breeding lines of soya beans and 550 breeding lines of cowpeas. The old varieties of soya beans give between 5 and 7 tons of hay per morgen. Some of the new varieties have already given an average of 13 tons of hay per morgen.

One new variety, called Blyvoor, had already been given out to farmers. Another variety, which is grown from seed, gives a yield of between 16 and 20 bags per morgen. The best planting time is from the middle of October to the middle of November, because soya beans require a very long day to grow well.

Mr. Muller hopes to have seed available at the end of next year for a dual-purpose soya bean. It is said to give a large quantity of hay or to yield 16 bags of seed per morgen. The interesting discovery was also made by Mr. Muller that by planting the soya beans an inch apart in the row all kweek grass is killed, and the mass of leaves offers so much shade that the soil remains moist in spite of hot days. His main aim with producing improved varieties of soya beans and cowpeas is to get plants which will not drop their leaves and which will push up the bean pods to the top, so that the seed can be harvested by machine and the hay left for grazing or the making of hay.

Witches' Broom Disease of Cocoa

Witches' Broom disease is the most serious malady of the cocoa tree in the Western hemisphere, and it has occasioned great losses in some West Indian Islands and on the mainland of South America. The disease is not known to exist elsewhere at present, but if it was introduced into West Africa, for example, taken in conjunction with the serious virus diseases already endemic there, the effect might be disastrous. On this account, it is important that the symptoms and characteristics of the disease should be widely known, and Her Majesty's Stationery Office on the advice of the Colonial Agricultural Advisory Council has recently published an excellent summarised account of the disease by Mr. Paul Holliday, cocoa pathologist at the Imperial College of Tropical Agriculture. With the sanction of the Colonial Office and the Stationery Office, we reproduce below a shortened version of this. The full text is issued by the Stationery Office as Colonial No. 286, price 9d.

THIS is a general account of witches' broom disease of cocoa. This disease of cocoa is the most destructive at present known in the Western Hemisphere, to which it is confined. It has been an agent, to a varying degree, in the very serious decline of cocoa production in Ecuador and Trinidad and its extinction in Surinam and Demerara.

The disease was first reported in 1895 from Surinam and its cause finally established there in 1915. In 1906 it was reported from British Guiana; from Colombia in 1917, from Ecuador in 1918, and later from Venezuela. It appeared in 1928 in Trinidad and has since spread throughout the island. Tobago recorded witches' broom for the first time in 1939 and it was found in Grenada in 1948. Certain high altitude parts of Colombia, the Bahia region of Brazil, the countries of Central America, and the remaining West Indian islands are free from infection as far as is known.

Cause of the disease

The cause of the disease is the fungus *Marasmius perniciosus* Stahel. Its systematic position is in the family Agaricaceae, in which are classified most members of the well-known ' mushroom ' and ' toadstool ' group. The fungus within the host plant, and invisible to the naked eye, is composed of microscopic threads (hyphae) which wind their way amongst the plant cells. The fruiting body by which the fungus reproduces itself is produced on the surface of the infected cocoa tissues and is easily visible, being a pinkish mushroom (sporophore) 1 to 2 cm. in diameter. The stalk bearing the cap of the mushroom is 1 to 2 cm. long and mostly whitish in colour. From the lower surface of the cap radiate white vertical plates of tissue known as gills. When mature, the mushrooms shed spores (basidiospores) from the gills, these being spread by air currents. The spores are microscopic, about one-hundredth of a millimetre long, and in mass are whitish in colour. The fungus does not extend throughout its host; each diseased shoot, cushion or pod results from a localised infection often by a single spore. It is eliminated from the tree when all these have been removed.

Symptoms of the disease

(a) *On vegetative tissue*

Newly infected buds, instead of growing normally, develop into the characteristic witches' brooms. The green stem becomes swollen, often two to three times the healthy diameter. This is due to the fungus stimulating growth, especially in the outer cell layers of the shoot. The internodes become shortened and proliferation of buds in the leaf axils occurs.

Terminal green fan broom

Leaves on brooms are normal except for their smaller size and a thickening of the stalk. Brooms may be terminal, due to the transformation of a leading shoot, or lateral when an axillary shoot is affected. Vigorous shoots may grow away from the infection and then a ' grown through ' broom results; this very often happens to attacked chupons. The fungal threads may penetrate a few centimetres into the twig beyond the broom itself, but each broom is the result of a single infection and if it is removed properly the rest of the branch remains healthy. Brooms are at first green, but later the host tissue dies, becoming brown and finally black. The leaves fall off before the broom itself, which may remain on the tree for two years.

(b) *On flower cushions*

Infected cushions may give rise to leafy cushion brooms very similar in character to vegetative ones. They are frequently very vigorous and may become at least a foot long. Malformed pods and flowers sometimes form on the broom itself. Infected flowers are distorted and are often produced in great profusion. Diseased cushions do not always produce cushion brooms but often small vegetative shoots will be found among the infected flowers. The brooms and flowers are at first turgid and retain their colour, but the host tissue gradually turns necrotic and dies.

(c) *On pods*

Symptoms take several distinct forms, depending either on the method of infection or on the age of the pod when it is infected.

I. Indirectly infected pods. These arise from diseased cushions and become infected by the hyphae of the fungus entering them from the cushion. From the start of development they do not grow normally but become approximately rounded. They rarely exceed 6 cm. in length and are usually much

smaller. At first green or red, they dry out to become black and very hard. Internally, they show no trace of developing ovules.

II. Directly infected pods. These are pods which become infected by spores alighting on their surface and germinating; they penetrate the pod through the stomata.

1. ' Carrot ' pods. If infected when about 1 cm. long the growing pod is completely invaded by the fungus and becomes carrot-shaped. The stalk thickens and the shoulders of the pod become high and broadened. The sides are straight and taper to a blunt tip, so that the natural oval shape is lost. The pod continues to grow but rarely exceeds 15 cm. in length before turning necrotic and hard. The beans, which remain small and undeveloped, are a total loss.

2. ' Distorted ' pods. Another kind of distortion is manifest when infection occurs in a pod 2 to 5 cm. long. A swelling in the shell develops in the invaded area and gives rise to a one-sided distortion. Ripening is premature and the swollen area becomes necrotic and hard. Internally, necrosis is widespread. The beans adhere closely to the shell wall and are valueless.

3. ' Indurated ' pods. Pods infected when 2 to 3 cm. longer than in (2) above show no external sign of infection until a necrotic area begins to develop on the shell as the pod ripens. Most commonly this occurs towards the centre of the pod. No distortion is apparent. Destruction of the internal tissues is greater than the external symptoms would suggest. Many of the beans are lost, but some may be recovered if infection has occurred only at one end of the pod.

4. Rind-infected pods. Yet older pods, when infected, develop a black speckling on the outside of the shell as ripening proceeds. Decay does not extend seriously inside the pod and if it is picked promptly no beans are lost.

All diseased tissues which have become completely necrotic produce mushrooms, after a dormant period of some months, when conditions are suitable.

Most types of broom symptoms are readily recognisable in the field by trained observers. Difficulties involved are physical ones, usually due to the height of old trees and their interlacing foliage, which restrict observation. Pod symptoms are often masked by other pod rots. Those occurring in areas where witches' broom is prevalent are ' black pod ' (*Phytophthora palmivora*), ' brown pod ' (*Botryodiplodia theobromae*), anthracnose (*Colletotrichum*

Lateral green fan broom

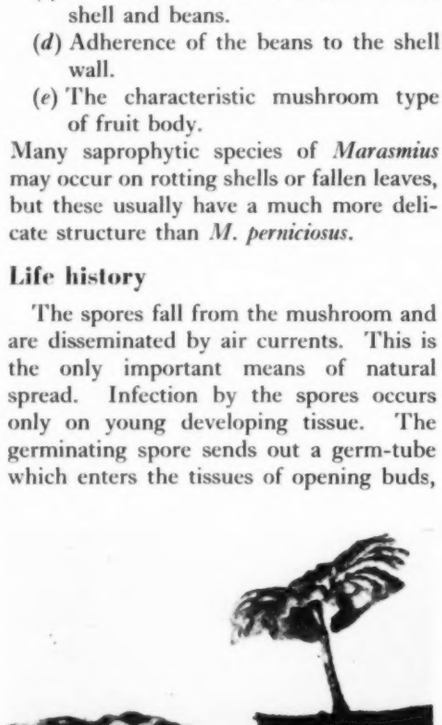
spp.), and in parts of South America, Monilia pod rot (*Monilia roreri*). Witches' broom infected pods may be distinguished from these by:

(*a*) Distortion.
(*b*) Extremely hard external necrotic areas.
(*c*) Extensive internal necrosis of the shell and beans.
(*d*) Adherence of the beans to the shell wall.
(*e*) The characteristic mushroom type of fruit body.

Many saprophytic species of *Marasmius* may occur on rotting shells or fallen leaves, but these usually have a much more delicate structure than *M. perniciosus*.

Life history

The spores fall from the mushroom and are disseminated by air currents. This is the only important means of natural spread. Infection by the spores occurs only on young developing tissue. The germinating spore sends out a germ-tube which enters the tissues of opening buds, young pods or developing flower cushions, giving rise internally to the hyphal threads, collectively known as the mycelium. An infected developing bud will grow out into an apparently healthy shoot and not usually until the second flush will the green broom appear. The incubation period is variable, but usually about six weeks. The broom is recognisable about two weeks later. After five or six weeks more, the broom loses its green colour and the host tissue dies, giving rise to the ' dry broom.' After drying out there is a period of dormancy before the mushrooms start to form. This averages five to six months, the extreme range observed being from 10 to 66 weeks. Necrotic symptoms on infected pods appear about three months after infection, but, except with indurated pods, evidence of distortion is visible some time before this.



Mushrooms—side view showing stalk and cap

Broom formation

Vigorously growing trees tend to produce larger brooms. Fan and cushion brooms are commoner than chupon brooms because chupons are normally removed at regular intervals. Considerable tree-to-tree variation in the number of brooms per tree occurs in Trinidad. Flowering intensity is strongly and positively correlated with cushion broom formation. In Trinidad the connection between flushing behaviour and the peaks of fan broom formation is masked by a climatic effect. A marked maximum occurs about February or March, after the end of the wet season, and a minimum about June at the start of the next.

The mushroom

These will develop under suitable conditions of rainfall and humidity on any diseased cocoa tissue where necrosis is complete. They are never produced on green brooms or on distorted pods where the tissue remains turgid. They are first easily visible to the naked eye as small pink dots about the size and shape of a pin's head, and become fully developed in rather less than seven days. The cap is at first convex and deep pink in colour; when the mushroom is well grown the cap becomes first flattish and gradually slightly concave as the colour fades. A mature mushroom begins to die after three days. Before this period has elapsed it can withstand a considerable amount of desiccation, and even after several days of hot, sunny weather it will revive and produce spores after rain. Eventually, 70% of all brooms produce mushrooms, and a single one may produce as many as 30 mushrooms in a week. When brooms fall mushrooms can be formed on the scar remaining.

Green cushion broom

The optimum conditions for mushroom formation in the field are not known in detail. Very wet days interspersed with occasional dry ones produce the most favourable conditions. The peak of mushroom production in Trinidad is at the end of the wet season, in December.

The spore

The spores produced by the mushroom are shed over a temperature range of 57° F. to 85° F. The heaviest deposition occurs between 60° F. and 80° F. Millions of spores are produced by one mushroom and each one is potentially able to cause an infection. Spore germination will occur only at a relative humidity of over 90%. Under favourable conditions germination is rapid, and 95% complete four hours from deposition. The spores are very susceptible to desiccation, and if one does not cause an infection on the night it is shed it is probably killed the next day. The spores formed on mushrooms are the only kind produced by the fungus.

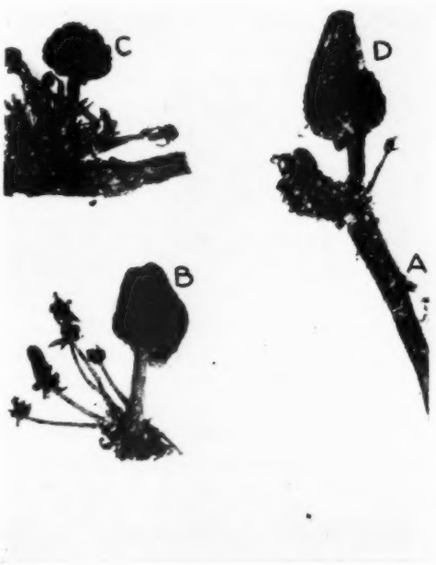
Epidemiology

The disease can be spread by means of its air-borne spores over considerable areas. Dissemination is intense over short distances, being most serious up to some 100 yards from the spore-forming mushroom. Under favourable conditions, infection will build up in a new area of vigorous and susceptible cocoa until an epidemic stage is reached. Such an area will continuously expand and may cause occasional outbreaks a mile or so away. The latter, if not attended to, will in turn become areas of high incidence. If an outbreak is uncontrolled, shoot infection increases to a peak more rapidly than pod infection. Since humid conditions are more favourable for the disease, it may be severe in the narrow confines of a river valley, whilst considerably less infection occurs on the hill slopes on either side. In Trinidad the epidemic stage has been reached in areas varying in rainfall from 70 to 130 in. a year. Ridges between valleys in which cocoa is grown act as natural barriers and isolated plantings often escape serious infection for a long time. The fungus has never been found attacking any species outside the genus *Theobroma*. There is therefore no risk of infection from plants of other genera.

Control

The destruction of all diseased material is the primary control measure which should be put into immediate operation.

All vegetative brooms should be removed together with about 6 in. of healthy stem. Routine pruning or shaping of the trees may be conveniently carried out at the same time. Diseased cushions should be totally removed flush with the bark. The mere removal of cushion brooms from the base does not prevent new brooms growing from the infected cushion left behind. Diseased pods are removed in the normal manner, except for those indirectly infected, in which the cushion must be cut out. All infected material removed must be destroyed by burning or burying and not left lying beneath the trees. This procedure must be carried out three times a year at four-month intervals. More frequent removal is not necessary in view of the time taken by the fungus to complete its life-history; but less frequent measures should not be resorted to unless studies of the local behaviour of the pathogen justify them. For example, in the West Indies the inhibitory action of the dry season on mushroom development enables one removal to be dispensed with, and two removals each year — in April - May and October — are generally considered sufficient. It is very important that the treatment should be regular and consistent from year to year. Irregular removal at differing intervals is much less effective, since the intervals between two consecutive removals will be either dangerously long or uselessly short. The four-month interval is specified because it is the minimum time, from the first signs of its appearance, that a green broom takes to become dry, produce mushrooms and cause new infections; it will be remembered that green brooms cannot cause infection. A few brooms left behind can do a great deal of harm, but if removal is carried out in the correct way the disease can be ignored during the intervals between treatments.



'Dry' diseased cushions producing a small broom (A) and directly infected pods (B, C, D)

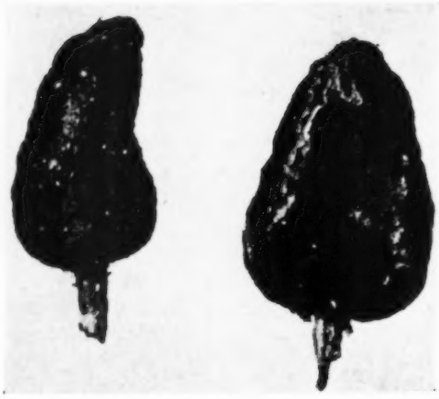
Treatment of old, tall trees of seedling cocoa has proved difficult. Expense can be a crippling factor when prices are low. Even experienced workers often miss brooms in the high interlacing canopy. The use of ladders, and the sloping land on which some cocoa is grown, slow down and increase the cost of the work considerably. If the incidence of shoot infection is high in such cocoa it is preferable to pollard the trees, cutting them back to leave only the trunk and primary branches. Where the disease is very severe on old trees, it is best to cut them down and replant, the more so if, as is likely, their yields are low. Control has been found to be much more efficient on regularly spaced trees in fields of uniform clonal cocoa, the higher yields from which repay the cost of proper control measures. The disease in such fields can be brought to, and kept at, a satisfactory low level.

The nature of the spread of the disease demands that control be carried out over areas of some 200 to 300 acres at a time; otherwise success will only be achieved in isolated plantations and in places with an unsuitable environment for the fungus. Large areas of continuous cocoa cultivation should be broken up into more manageable field units separated by traces and windbreaks or strips under other crops. A higher standard of agricultural practice, which means treatment of cocoa as an orchard crop, will increase the degree of control achieved.

Treatment by spraying has never proved satisfactory, though it is possible that some control of pod infection will be effected by copper sprays. Further work is required before definite recommendations can be made.

No immunity from witches' broom disease has been found in Trinidad cocoa, but different degrees of resistance have been found in clonal selections. Some differences in resistance are significant and the planting of those clones less susceptible to the disease will materially strengthen other control measures. Immunity is known to exist in the upper Amazon valley and two immune Amazon forastero clones have been brought to Trinidad; little is yet known of their bearing capacity or quality. At present there is no satisfactory alternative to the direct control measures described here, which are successful if efficiently performed.

The control measures described above are applicable to Trinidad, where the disease is now well established, and when carried out thoroughly permit the cultivation of cocoa without serious economic losses. In West Africa, however, the disease does not occur and its introduction would be a disaster of the first magnitude. It is extremely important to keep the territory free from infection if at all possible. The only hope of doing so is for everyone to keep a sharp look-out for this disease and report any suspicious growth immediately to the Director of Agriculture. Specimens would be valuable for diagnosis but care should be taken to enclose them in a sealed box, otherwise they may spread infection. Mushrooms should be placed in a box by themselves and labelled ' mushrooms.' As soon as the presence of the witches' broom fungus has been confirmed machinery for a rapid survey of the whole affected area can be put in motion. If the outbreak is localised then large-scale eradication measures already planned can be put into operation immediately. Only by prompt and vigorous action is there any hope of successful eradication, and the co-operation of everyone concerned will be urgently required.



'Dry,' directly infected, strawberry-shaped pods

Fertilisers in Economic Use

D. P. HOPKINS, B.Sc., F.R.I.C.

In this article, Mr. Hopkins discusses certain economic factors attending the use of fertilisers in farming. His illustrations are drawn from practice under English conditions, but with due allowance for changed conditions they apply equally to conditions in other countries where intensive farming is practised.

FERTILISERS are economic commodities. This is a truism that cannot be overstressed. It is not enough to show that fertiliser applications produce higher yields. Innumerable plot and field tests over the past hundred years have demonstrated this, yet even in the highest-using countries rates of application rarely reach the optimum levels recommended by independent and scientific studies.

Profits from fertilisers

For most crops there is ample evidence to indicate the expectable gains in yield from various levels of fertiliser usage. Certainly this is true for all major farm crops. Testing has covered most local variations in soils and also regional variations in climate. In any case, whenever there is doubt a minimised estimate of the expectable increase in yield can be conservatively taken. It is not difficult to calculate the actual cost of a specific fertiliser application—all factors are known, the cost of materials, the labour charge of the operation itself. The value of the expectable increase in yield can also be calculated, although for some crops it may be more uncertain, as a calculation in prospect; however, we are not going through a period when growers cannot tell even a few months ahead whether they are raising wanted or unwanted food, and (with the exception of certain vegetable crops at peak-seasonal times) few farmers or growers are unable to estimate reasonably accurately the *minimum* price their crops will fetch. The profitability of a fertiliser application can be assessed simply enough. The input cost being known, the value of the resultant output being also known or safely predictable, profitability can accordingly be expressed either on a cash-per-acre basis, or preferably as a percentage upon the cost of the fertiliser. When the latter course is adopted, it can be shown in most cases that there are few more attractive returns on short-term investment available to farmers.

Fertiliser subsidy removal

The importance of this approach to fertilisers was shown in Britain when fertiliser prices rose sharply as a result of the cessation of subsidies. Previously, subsidies had kept fertiliser prices almost at their pre-war level, and the actual change in prices was therefore steep. Nevertheless, fertiliser usage still remained a highly profitable investment, returning from 50% to 150% profit in less than twelve months for most annual crops. This was not, however, realised by many farmers and fertiliser consumption in Britain fell sharply for the first time in a long series of years. It is certain that many farmers lost considerably more farm income than the money they saved by not using as much fertiliser as in previous years, and although subsidies (for nitrogen and phosphates but in a different form) have since been re-introduced, fertiliser consumption in Britain has still not regained its peak level before subsidy removal.

Crops used on the farm

It is more difficult to estimate fertiliser profitability for crops that are used on the farm rather than sold as cash-crops. There is plenty of evidence to show that appropriate fertiliser applications greatly increase both the yields and protein value of grass for example, but the value of

TABLE I

	Group 1	*Group 2*	*Group 3*
No. of farms	12	11	12
Average expenditure on fertilisers per acre	29s. 10d.	19s. 2d.	8s. 0d.
Fodder-producing acreage per cow ..	3.02	3.06	3.01
Average milk yield per cow (gal.) ..	671	641	542
Average milk yield per acre (gal.) ..	222	209	180
Value of milk per acre calculated at pool prices, 1942-47	£28 13s. 6d.	£26 19s. 11d.	£23 5s. 0d.

these gains can only be shown in the eventual results of utilisation, in extra milk per cow, or in lower costs per gallon of milk, etc. The fertiliser effect in such cases is a long way removed from its final expression in money, and a number of other variables may intervene. Studies of a number of farms—the typical surveys of university agricultural economics departments—are probably the best means of showing fertiliser profitability on stock or dairy farms.

Actual examples of the economic approach to fertiliser usage and its expansion will be more revealing than generalised description. Here are a few, one from the past, but most of them fairly contemporary.

Nitrogenous fertilisers and wheat

An analysis of 150 field trials between 1896 and 1940 (Cowie) showed that a dressing of 1 cwt. of sulphate of ammonia gave an average addition to yield of 2.4 cwt. of grain and 4.8 cwt. of straw. Also, that a 2-cwt. dressing of the same fertiliser gave an average extra yield of 4.6 cwt. of grain and 9.9 cwt. of straw.

It is not correct to assume, however, that on all soils increases of this order can annually be secured from nitrogen alone, though it can certainly be said that on land in good heart such yield gains will be obtained until potash and phosphate reserves have suffered depletion.

Last year in Britain sulphate of ammonia, after allowing for subsidy help (£3 3s. per ton), would not have cost farmers more than 14s. 6d. per cwt. Last autumn the average price for grain reported from over 100 centres was 28s. 5d. per cwt. For caution, let a lower rounded-off figure of 27s. be taken. Thus, a 1-cwt. dressing costing (materials only) 14s. 6d. produces 2.4 extra cwt. of grain, worth £3 4s. 10d., equal to an additional profit of 50s. per acre; similarly, the 2-cwt. dressing leads to an additional profit of 95s. per acre. The actual cost of application has not been debited; nor has the value of the extra straw been credited. These are factors that will vary from farm to farm, but it is a safe enough generalisation to say that in most cases the credit will outweigh the debit. In economics, especially in agriculture, it is always wise to err on the side of caution.

Let the profit figures for the two dressings be reduced from 50s. to 40s. (1 cwt.) and from 95s. to 75s. (2 cwt.). They still show percentage rates of profit on the investment cost of 274% and 258% respectively.

However, many farmers do not apply as much as 1 cwt. of sulphate of ammonia per acre of wheat (or its equivalent in a compound fertiliser); and few apply as much as 2 cwt. Indeed, a recent area survey showed that only one in ten farmers had used nitrogen for wheat.

Effects of phosphates and potash

Evidence is not available to show exactly what average increases in yield can be expected from wheat on land requiring phosphates and potash as well as nitrogen. There are many variations and much of Britain's cereals are today grown on thinnish soils of low plant-food reserve and holding power. We can, however, take an exceedingly conservative estimate, namely, that a 4-cwt. dressing of a compound (N, P and K) fertiliser will give at least 4 extra cwt. of grain and from 5 to 10 extra cwt. of straw. Indeed, on all but the poorest soils, farmers should achieve these results from 2½ to 3 cwt. applications.

At 1952-53 fertiliser prices in Britain (rather higher than 1953-54 prices) a suitable compound fertiliser would not have cost more than 16s. per cwt. The costs of application will have been low, for such dressings today are carried out on most farms by combine drilling. Thus, a 4-cwt. dressing costing 64s. will have given (at 1952 harvest prices) an extra yield of grain worth 108s. (plus the value of the extra straw)—a gain of 44s. per acre. This shows a percentage profit on the investment in fertiliser of over 60%, and here the costs of nutrient requirement on *poor land* are being fully covered. On land, where only 2½ cwt. of a compound fertiliser would be needed to give the quite moderate extra yield of 4 cwt. of grain, the percentage profitability rises to 170%.

Size of yields and profits

There is another angle from which fertiliser profitability *to the farmer* must be considered. In 1951-52 the University of Nottingham Agricultural Economics Department kept full accounts of all costs for 32 wheat fields on 30 farms in a single area. Yields varied considerably, but one clear conclusion could be drawn—that high profitability followed high yields per acre. The lowest yields had an average cost of £20 12s. 2d. per acre and in the outcome these crops lost money; the highest yields cost an average of £24 0s. 8d. per acre, but they showed the remarkably high average profit per acre of £45 13s. 1d. There are serious items of fixed charge falling upon every acre, whether low or high yields are harvested, *e.g.* rent or interest on capital invested, cost of seed and sowing, cultivation costs. These are basic costs and their incidence per cwt. of final crop is very high unless a high yield is secured. To quote from the Nottingham University report: 'As yields increase, returns increase proportionately, and as variations in costs are small and irregular the margins increase tremendously with increases in yield.'

Fertilisers and milk

A five-year economic survey of dairy farms was recently reported by the Farm Economics Branch of the University of Durham. The farms were grouped according to their levels of fertiliser expenditure per acre. The results, as tabulated in Table I, tell their own story.

D. H. Dinsdale and T. Winter, who conducted this survey, concluded that 'on many farms a first step towards achieving higher milk output per acre could well be a revision of attitude towards the use of fertilisers *within present cropping programmes*.'

In this survey, the differences between fertiliser usage do not indicate an intensive attitude. The highest average rate, just under 30s. per acre in cost, is no more than an expression of moderate rates of application, about 3 cwt. per acre per annum level. Yet the extra outlay of 21s. 10d. per acre between Group 1 and Group 3 is associated with an extra milk output worth £5 8s. 6d. per acre—equivalent to a profitability rise of about 400%. The difference between Groups 1 and 2 shows a profitability rise through greater fertiliser usage of 230%. It is true that where dairy farm management is more fertiliser-minded we can expect management also to be more efficient in other operations that increase yields and reduce costs per gallon produced. Nevertheless, additional contributory influences cannot wholly explain such large differences in profitability.

More recently still, results obtained on a small Welsh dairy farm of 65 acres have been published by the Central Agricultural Control Department of Messrs.

TABLE 2

Type of Farm	Averages per 100 acres			
	'Best Six in Group'		Entire Group	
	Expenditure on fertilisers	Net farm income	Expenditure on fertilisers	Net farm income
	£	£	£	£
Cash cropping (over 150 acres)	435	1,869	352	1,068
Cropping with livestock (under 150 acres) ..	239	1,072	158	499
Cropping with livestock (over 150 acres) ..	276	1,064	219	695

Imperial Chemical Industries. On this farm, despite the rising costs of fertilisers during the period, the increases shown below were made in applications.

PLANT NUTRIENTS IN LB. PER ACRE APPLIED PER ACRE TO ALL GRASSLAND

	1948	1949	1950	1951
N	71	75	136	174
P_2O_5	52	130	81	51
K_2O	21	17	14	57

The following results were associated with these changes in fertiliser policy. The total annual milk production rose from 11,228 gallons in 1948 to 15,556 gallons in 1951. The cost of milk production steadily fell from 31.2d. in 1948 to 23.8d. in 1951, although in the same period the actual costs of fertiliser per acre for three-year leys rose from £2 18s. to £8 12s. On very few farms in Britain would such a high rate of nitrogenous fertiliser usage be attempted—the 1951 rate represents the equivalent of 7½ cwt. of sulphate of ammonia! Nevertheless, the silage produced enabled major economies to be made in purchased concentrates—the weight needed per gallon of milk produced fell from 2.16 lb. in 1948 to 0.63 lb. in 1951.

Two other cases of dairy farm economics, as influenced by intensified fertiliser usage, are described in the same publication, and their careful examination may be recommended.

Fertilisers and fruit

When payment for quality enters the economic picture, the appropriate use of fertilisers is not less important. This is shown by a pre-war example from the East Malling Research Station. Mere total weight of a fruit crop is not a direct indication of its market value. The quality of the fruit, the proportion of 'culls,' etc., must be taken into account. As is well known, potash is a quality-influencing nutrient for most fruit, and particularly for apples. Here three rootstocks of Bramley seedlings were considered for yield and value of yield with and without potash.

	With Potash		Without Potash	
	Bushels per acre	Cash value	Bushels per acre	Cash value
Rootstock I	615	£154	502	£68
Rootstock II	387	£98	549	£74
Rootstock III	359	£73	264	£32

In one case a smaller yield was produced, but its market value was nevertheless 25% higher; in the other two cases both yields and values were higher with potash, the latter being at least 100% increased in each case. Even at post-war prices, dressings of, say, 5 cwt. of potash per acre would cost an insignificant sum compared with these differences in crop yield value; there is, therefore, little point in calculating the remarkably high percentage of profit shown on the actual money investment in potash in this case.

Fertilisers and farm income

Must farm income be high before much money can be spent upon fertilisers? Or does higher expenditure lead to higher income? It may need courage and confidence for a farmer with low income to invest more in fertilisers, but the fact that this course is one of his surest roads to increased income is borne out by another university survey of farm economics. In this survey the full costs of 253 British farms in the Midlands were studied. Farms were grouped together according to type and size (above or below 150 acres). In each group budgetary items were averaged for 'the best six' as well as for the group as a whole. In three groups, 'the best six' spent appreciably above their group average on fertilisers. It is hardly a coincidence that the incomes of these farms were also appreciably above the average incomes for their groups (Table 7).

Here again it must be borne in mind that fertiliser-mindedness is almost certainly allied with other factors of management efficiency. It would be over-simple to assume that the 21% extra expenditure upon fertilisers on the best six cash-cropping farms was the only influence leading to their 80% greater income per 100 acres. Nevertheless, where livestock is carried and manures are therefore available, the fertiliser effect upon income would not be so emphatic were it not one of the more dominant factors. Yet for the small and larger mixed farm groups we find respectively that a 50% greater expenditure on fertilisers is associated with farm incomes about 110% above the group average and a 26% greater expenditure with 53% superiority in farm income.

Conclusion

These varied examples of economic presentation—fertiliser effects in terms of money—are not, of course, a comprehensive selection. They are merely instanced here as illustrations of the educational approach that is likely to be more effective in future in all countries where a basic level of fertiliser usage is already fairly well established, *e.g.* Britain, North-West Europe, the U.S.A., etc. The production of food in these countries can only be expanded or cheapened in cost (or both) if the fertiliser-usage of the less efficient farms is raised to the usage levels of the best. Above all, this is a task of persuasion and the economic use for fertilisers, though exceptionally under-emphasised in the past, is far more striking than the purely scientific case based upon field tests and yield data. In general, fertiliser prices have risen in the past few years. There is perhaps some future prospect that prices for crops will not in all cases rise as much as the costs of production. It is urgently necessary, therefore, to convince the more nervous or uncertain farmers that decisions to cut costs by spending less on fertiliser—or at any rate not spending enough—are in fact decisions to cut far more severely their potential rates of profit per acre. The very high return on fertiliser expenditure leaves ample room for the absorption of adverse changes in fertiliser prices or market returns for crops.

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Cable Controls

Caterpillar cable controls, both rear and front mounted, are the subject of a new booklet recently released by the Caterpillar Tractor Co. Several cutaway and model views facilitate illustration of the advantages of No. 24 front mounted unit and the No. 21, No. 25 and No. 27 rear mounted controls.

Aerial Photography as an Aid in Planning Improved Land Use and Flood Control

R. MACLAGAN GORRIE, D.Sc.

In this article, Dr. Maclagan Gorrie, who has of late years been engaged on soil conservation work in Ceylon, and prior to that was for long a member of the Indian Forest Service, describes how aerial survey methods can be of use in planning land use and the control of soil erosion, taking his examples from the Kotmale river headwaters area in Ceylon. An account of the methods used in aerial work appeared in WORLD CROPS, *vol. 3, p. 469.*

ANY comprehensive and constructive approach to the control of floods and the better utilisation of available rain run-off must depend upon an analysis of the soil erosion problem, because the amount of usable water is inevitably much smaller than the total run-off from floods. Water can be stored in surface tanks as well as by sub-surface storage conserving moisture in the soil. The regime of the small feeder streams in the mountain catchments can be greatly improved by employing the French and Swiss techniques of torrent correction. These aim chiefly at making each torrent bed into a series of steps and stairs with rough masonry check-dams which prevent further deepening of the V-shaped gullies. Further downstream the larger streams inevitably suffer from bank erosion and this leads to slumping and earth avalanches. These in turn can be cured to some extent with the appropriate techniques of landslide revetting and river bank consolidation.

The problem of water conservation

In less mountainous lands and in the vast stretches of arid uplands, such as the Sudan and Punjab where canal irrigation is not feasible, the problem of water conservation is of supreme importance and has been simplified to some extent with the invention of heavy soil-moving machinery. The principle of the farm pond is to trap enough water to irrigate a few acres of terraced field during the ensuing dry season, or merely store the water for the use of men and livestock. Work on these lines was in progress in the Punjab from 1938 onwards, bulldozers being used in Hoshiarpur and Ambala for banking and excavating water-retaining tanks. The principle is an old one fully understood by the landlords of Rawalpindi and Mianwali, where this is the time-honoured task for Pathans using donkeys as the means of moving the soil, but masonry is also used in the construction of the water-holding and silt-holding dams. In the Sudan, this type of excavated tank is known as a 'hafir' (*vide* B. Levick, *New Commonwealth*, p. 553, May 25, 1953).

To plan any of these works in detail normally requires intensive study of the ground conditions to analyse the efficiency (or otherwise) of the various types of forest, systems of grazing, crop rotations, methods of field cultivation, intensity of population settlement, road systems, and in fact all the factors which are now grouped under the general heading of 'land use,' but with a bias towards the effect of the misuse of land in exaggerating flood conditions and the intervening droughts and water shortages.

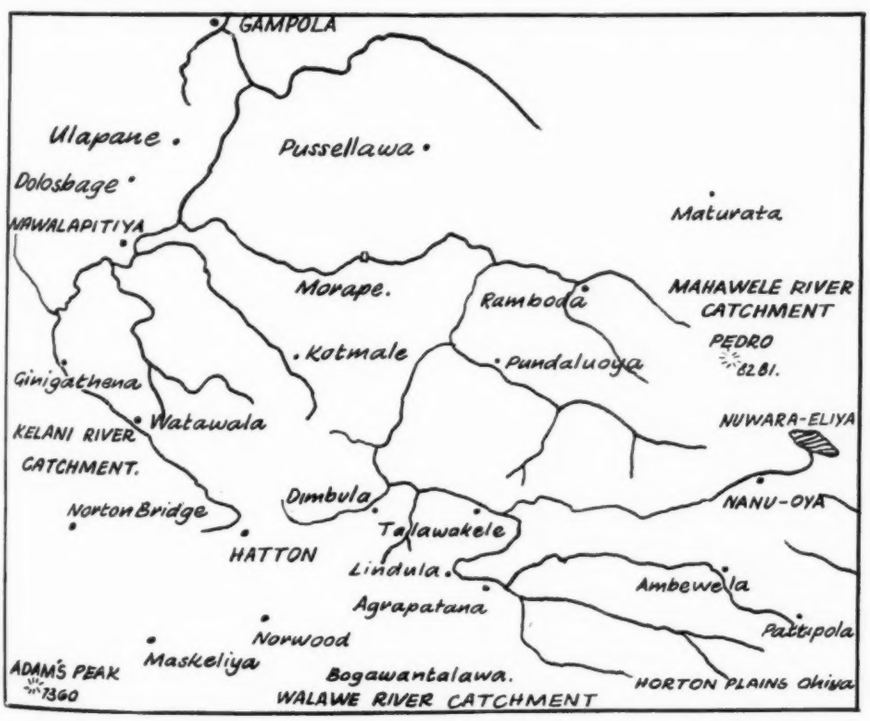


Fig. 1. Map of Kotmale River Catchment, Ceylon

The use of air survey methods

The use of air survey will, however, go a long way in reducing the time spent on field work. A sample air survey of the headwaters of the Kotmale (Fig. 1), a tributary of the Mahawele River of Ceylon, has been used to show in some detail how air photos have been employed in planning for some of these specific problems. Under the Soil Conservation Act, Ceylon, 1951, rules have been drafted for specific conservation measures to be introduced into an area of about 450 square miles of steep hill country at the head of the Mahawele and Kelani rivers, both of which are now being harnessed for hydro-electric power as well as for irrigation. A comprehensive report has been prepared for the Ceylon Government based on air and ground reconnaissance and laying down the best ways in which the local land uses can be improved to secure a larger percentage of usable water from the immensely heavy monsoons and intervening dry periods.

The Kotmale catchment

The main points in Kotmale land use requiring attention are:

(1) *Forests:* Much of the reserved forest and crown land and privately-owned *patna* (grassland) has deteriorated seriously. The existing forest has deteriorated both commercially and in its catchment value. A comprehensive plan for reforestation of land previously under trees and afforestation of grass *patna* is needed.

(2) *Tea estates:* Rules have been drawn up in agreement with the leading planters. This will ensure that the best-known soil conservation practices will be enforced by law, but will require a considerable trained field staff for inspection and enforcement.

(3) *Tea smallholdings:* The same standard of stocking and maintenance as in the best estates should be aimed at and the village tea growers should be helped and educated towards securing that standard. At present the smallholdings are a source of very serious erosion, and only a small start has been made to help them and ensure improvement.

(4) *Paddy:* Excessively heavy irrigation is one of the main causes of landslips. A rigid economy of water use must be introduced. The beds of hill torrents used for irrigation should be trained after the Swiss alpine model so that better water use and more effective flood control is established.

(5) *Other village crops:* The cultivation of annual crops on unterraced slopes must be controlled so that excessively steep slopes are withdrawn and transferred to cardamom or forest crops. Within the permissible slope for annual crops fields should be terraced with stone or grass banks to form bench terraces.

Air surveys

The particular tasks in the planning of which air survey has proved to be of value are set out in the following paragraphs.

Afforestation and the location of deteriorating forest

The effectiveness of forest cover on land which has been officially allocated to catchment protection (over 5,000 ft. altitude) can be seen at a glance, *e.g.* all 'sore spots' such as buffalo wallows, cardamoms cultivation under partial clearance of canopy, or extension of bare slab rock patches through sheet erosion. Afforestation or complete closure to grazing should be specified for such places.

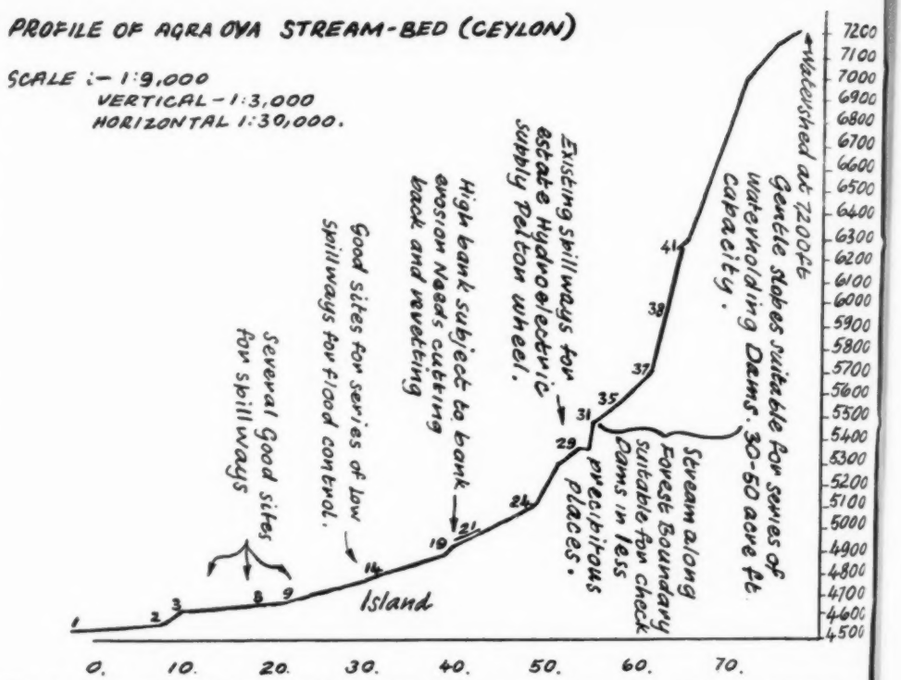
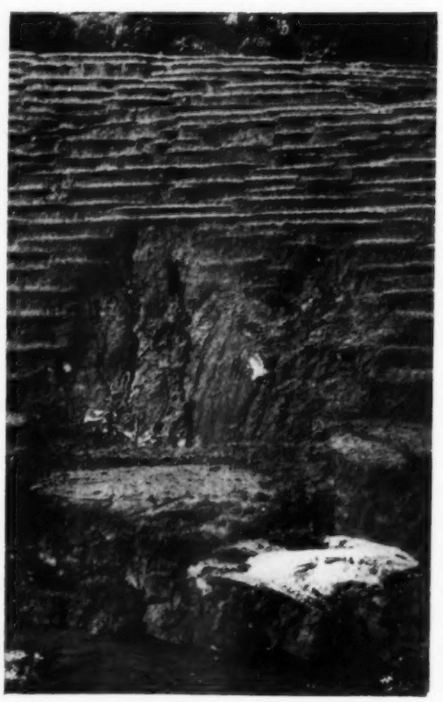

PROFILE OF AGRA OYA STREAM-BED (CEYLON)
SCALE :- 1:9,000
VERTICAL - 1:3,000
HORIZONTAL 1:30,000.
Several good sites for spillways
Good sites for series of low spillways for flood control.
High bank subject to bank erosion Needs cutting back and revetting
Existing spillways for estate Hydro-electric supply Pelton wheel.
precipitous places.
Forest Boundary suitable for check dams in less
Stream along
Gentle slopes suitable for series of waterholding Dams. 30-50 acre ft capacity.
Watershed at 7200ft
Island
0. 10. 20. 30. 40. 50. 60. 70.
7200 7100 7000 6900 6800 6700 6600 6500 6400 6300 6200 6100 6000 5900 5800 5700 5600 5500 5400 5300 5200 5100 5000 4900 4800 4700 4600 4500

Fig. 2. A drawing of the profile of the Agra Oya stream-bed. The original graph of this profile was plotted from spot levels established stereoscopically from aerial photographs

Grass fires

Appreciable areas of grassland (*patna*) should be afforested in order to reduce the incidence of grass fires. It was a common belief amongst foresters and tea planters that this *patna* was ecologically a climax formation, but recent discussions have tended to show that grass is a permanent climax only in so far as grass fires prevent re-introduction of tree growth. A fire-fighting plan should include high look-outs and cut fire lines, and these can be planned and located effectively on an air mosaic and from contoured or form-lined maps prepared from the air photographs. The actual prescription of the plan will vary according to whether the land belongs to government or private owners; accordingly, legal boundaries require to be checked and entered on the map and on the mosaic before a community fire plan can be agreed upon.



A landslip in steep paddy terraces caused by excessively heavy and continuous irrigation which renders the whole hillside unstable

Torrent correction

The use of boulders for rough masonry check-dams has been practised for many years by both Switzerland and Austria under the provisions of the Rhine Flood Commission. France has also employed a similar technique in the Arc Valley of Haute Savoie in reducing avalanche and landslip damage. A similar approach has been strongly recommended in recent instructions issued by FAO, whose Forestry and Soil Conservation Sections are fully alive to its value in supplementing normal afforestation and field cultivation control measures.

Each torrent bed has to be surveyed from the watershed line downwards to

locate in detail the positioning of small water-holding dams and boulder check-dams, the clearing of islands and obstruction from the stream bed itself, the re-vegetation of eroded banks and the ' manicuring ' of unstable eroded banks by levelling them off to a more stable slope before replanting. The best basis for planning such work is the air photo which under a stereoscope gives a vivid impression of the stream bed. To this should be added a profile of the stream bed which can readily be plotted from levels read off on any three-dimensional stereo-plotter. As a sample, the Agra Oya, a tributary of the Kotmale, has been worked out and specified works marked on the profile, which was originally compiled from air photos (Fig. 2).

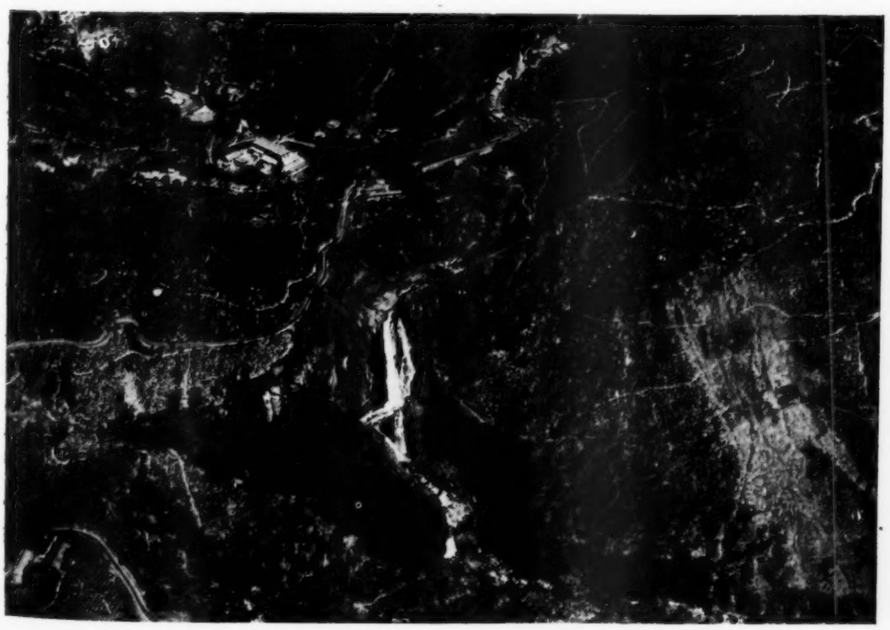
River training

Having dealt with each individual head-stream under torrent control, the next step is to follow the drainage system down-stream and plan in detail whatever flood prevention works are feasible. This is really an extension of the torrent correction technique, but one quickly runs out of the small streams into the larger ones in which check-dams are definitely not feasible. The working rule used in practice in the Hoshiarpur Siwaliks of East Punjab was that check-dams should be confined to the top square mile of each torrent's catchment, or to a bed width of not more than 16 ft., whichever is less. Below this point the work should concentrate on the removal of islands and obstructions, the planting of bare banks with suitable flood resistant plants, and the ' manicuring ' of over-hanging earth-cliffs before they are re-planted. Likely positions of all natural dam sites for storing flood water should also be noted from the photo survey for subsequent examination on the ground.

Soil creep apparent along the bottom of a block of paddy terraces near Pundaloya in the Kotmale valley. The men are standing in a soil crack caused by the bulging of the heavily irrigated terraces

Soil conservation in estates

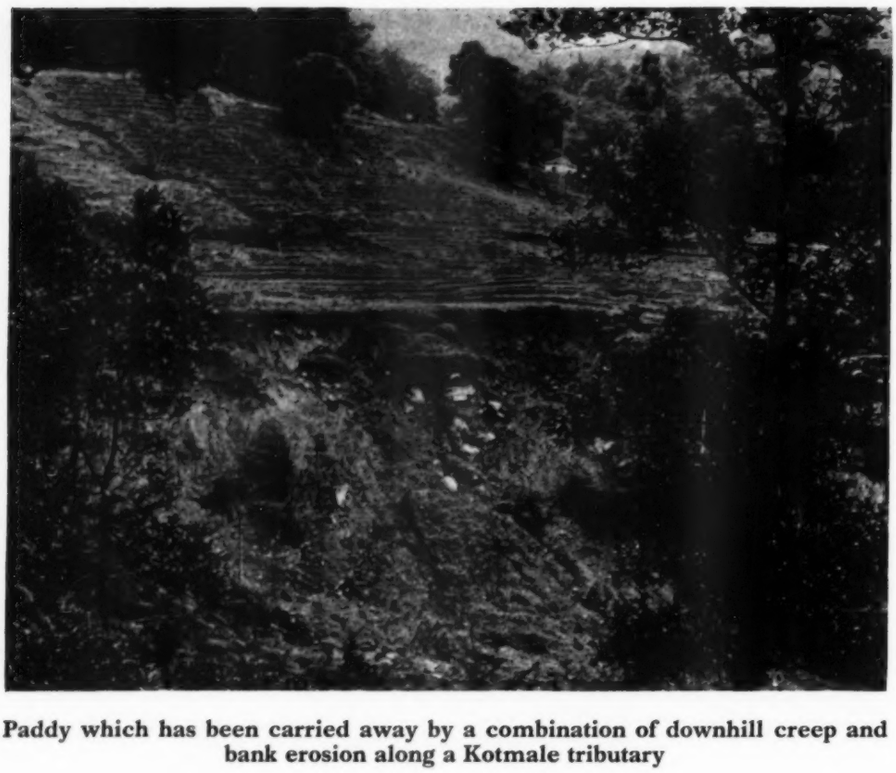
Under the Ceylon draft rules the intention is that certain soil conservation measures will be rendered obligatory, including the planting with trees of bare eroding ground and the withdrawal from cultivation of tea which falls below a minimum number of bushes per acre. The commercial estates affected by these rules will presumably be given a statutory period of, say, five or ten years, within which to carry out these works. Each estate will be asked to produce a working plan laying down a programme covering five or ten years and at the beginning of each year an annual tree-planting task will be drawn up. Analysis of bare and eroding areas can best be done from air photos and in the case of siting individual check-dams, photos on a scale of 1/8,500 have proved of considerably more value than from higher up. In many tea estates the alignment of old field drains is much too steep, so that a re-alignment will be necessary to comply with the soil conservation rules. Under a stereo plotting machine a ' form line ' map which gives relative contours will give a basis for the best re-alignment for each field for a series of drains with a maximum side-slope of 1 in 80. By using a three-dimensional stereo-plotting instrument it is possible to produce a map with ' relative contours ' without going to the cost of establishing a level framework on the ground. ' Relative contours ' of this kind can be relied on to give the relative height of local features but cannot be used to establish an overall gradient over several miles.



An oblique air photograph of the Devon Falls, Ceylon, taken by Hunting Aero-Surveys Ltd. during their Kotmale reconnaissance. To the right of the fall is a serious landslide of about ten years ago which has been partially reclothed by planting and sowing leguminous crops

Smallholdings

The improvement of down-at-heel agricultural holdings is easier to plan than to get carried out, because the improvements, though fairly obvious technically, are difficult to carry out in face of poverty, over-population, bad hereditary methods, fractionised holdings and the legal difficulties facing any attempt at consolidation of holdings. In many countries, the boundaries of individual holdings are ill-defined, both legally and on the ground, and multiple ownership is carried to extremes, such as one family having a fractional share of a field once in every 10 or 20 cropping seasons. The approach by government cannot therefore be the same as in the case of big commercial estates and constitutes an educational problem



Paddy which has been carried away by a combination of downhill creep and bank erosion along a Kotmale tributary

rather than an enforcement. Even so, however, the use of air photos is of the utmost value in showing, for instance, where evacuation of holdings is advisable to get homes moved away from the close proximity of landslips, and also in planning the layout of stone or turf terracing to secure permanent contouring to improve the cultivation of unterraced slopes. The use of relative ' form lines ' instead of true contours will give an adequate generalised planning of terrace walls which should, of course, be built truly level or with a very slight side slope to secure that only surplus water reaches the nearest hillside drain.

Excessively steep cultivated slopes

The modern conventions of land use classification based upon relative steepness of slope, according to American standards, is at variance with established practice in Ceylon, where tea planted 60 to 100 years ago on slopes of up to 1 in 2½ or even 1 in 1½ is still fully productive. American practice would rule out all cultivation from slopes of over 1 in 6, but these older established plantation industries have disproved this. Care is therefore needed in applying any arbitrarily fixed maximum slope for a given crop. The semi-permanent crops, such as tea, coffee or rubber, etc., can be allowed to carry on on slopes which are far too steep for unterraced annual crops such as maize, tobacco and manioc. Fixing the maximum permissible slope is of more importance as a check on what is economically feasible rather than in terms of total prohibition.

On the other hand, enormous soil losses are being incurred through the unterraced cultivation of ordinary slopes for annual crops, so contour terracing should be insisted upon for all forms of annual crop on any slopes. The generalised planning of the layout of a set of contour terraces can readily be done by photogrammetric methods.

Increased food production in the non-irrigated tropics depends largely upon the adoption of terracing to save the soil and build up a more permanent fertility. Apart from the paddy land which is already terraced and whose terracing is repaired between each irrigation season, the other annual food crops are maize, manioc or cassava, *kurrakan* or millet, chillies, onions, potatoes, sweet potatoes or yams, plus non-food but valuable cash crops such as tobacco. When grown on steep slopes without terracing the soil becomes so impoverished that the field has to revert to grass or scrub-jungle for a period of years before it will yield another crop. If, on the other hand, the land is properly terraced into a series of level benches, each supported by a wall of stone or turf, that field will remain permanently in production. Continual fertility will, of course, depend upon regular manuring and other good farming practices in addition to the terracing, but the provision of the terracing is the first and essential step towards a sounder and more permanent agricultural economy.

Landslides and soil creep

In many tropical countries the excessively heavy use of irrigation water on steep hillside terraces is leading to instability and soil creep. Particularly where an underlying rock such as granite disintegrates into kaolin or montmorillonite clays, the rot can go down to considerable depths and render a whole hillside unstable. Major movements such as old landslides can be fairly readily identified on air photos and their perimeter marked for remedial action, but slow soil creep is more difficult to identify and will require careful correlation of air photos with ground conditions on areas where soil creep has been authenticated over a period of years. Symptoms to be looked for in photos are: Grouped bulgings in the general layout of a series of field terraces; ends of mud ridges dragged askew where they abut on a crack or fault; and overhang of displaced surface soil at the top of a road-cutting or eroded river bank.

Injudicious irrigation is the prime cause of landslides in many tropical countries where rice is the main subsistence crop. In the Kotmale valley some 60 major slips occurred during one heavy storm in 1947 and subsequent damage by slower soil creep has become widespread.

The technique for revetting active landslides aims at reducing the surface movement of water into the affected area plus the encouragement of a thick plant cover which will bind the surface soil, using wattle hurdles and stakes to secure a temporary stability while the plants are taking root. In the case of soil creep, the main thing is to get the irrigation stopped and this is inevitably a source of grievance which makes enforcement difficult.

I am indebted to Messrs. Hunting Aero Surveys Ltd. for their help in preparing the Agra Oya stream profile and for their courtesy in allowing the use of air photographs.

Caterpillar Plant

The selection of Decatur, Illinois, as the site of a new manufacturing plant has been announced by Caterpillar Tractor Co. Decatur is located approximately 70 miles south of Peoria where the company's general offices and largest plant are located. Plans for the new plant are part of the company's post-war expansion programme. The total cost of new machinery and equipment at all plants, and of land and buildings at the new plant, in the latest realignment of the company's manufacturing facilities, is estimated at about $45 million.

Thermal Fog for the Control of Insect Pests in Forests and Plantations

D. BOOCOCK

(*Insecticides Division, The Standardised Disinfectants Co. Ltd.*)

Thermal smokes have attracted considerable attention of late years for controlling insect pests. They have obtained their widest use in fumigation in public health work and for controlling insects attacking stored products. They have, however, also attracted attention in controlling insect pests in forests and also in orchards; the position in this regard is reviewed and described below.

WHEN insecticidal fog generators were first tested they were considered promising for public health purpose and for the control of agricultural pests. Today, many fog generators are in regular service in public health work and for industrial pest control but, generally speaking, they have failed to establish themselves in agriculture, the main reasons being their dependence on the weather and the smallness of the insecticidal particles of which the fog is composed.[2] In forests, however, where weather conditions are more favourable and smaller particles effective, fog generators have given excellent control of a number of insect pests. Before giving details of these results it is necessary to describe the principal types of generator as there seems to be some confusion on the subject.

Fog generators

The fog generators at present available fall into two main types: those using superheated steam to reduce the insecticide solution to a fog cloud and those using hot air for the purpose.

The 'Bes-kil' machine

The American machine known as 'Bes-kil' is the best known example of the steam-operated type. It is driven by a 6 h.p. petrol engine which operates a two-cylinder plunger-type pump, one cylinder of which pumps water through a forced-circulation, continuous-flow steam generator, for which heat is supplied by an oil burner. The other cylinder supplies the insecticide to the fog nozzle of the machine where it is converted to fog by the superheated steam expanding at considerable velocity. The machine uses 31 Imperial gallons of water per hour, 4 gallons of diesel oil, and a quarter of a gallon of petrol to disperse 31 gallons per hour of insecticide as fog. The particle size of the fog can be altered by varying the steam temperature—the higher the temperature, the smaller the size of the fog particles. The dry weight of the 'Bes-kil' machine mounted on skids is 660 lb.

The 'Tifa' machine

The Todd insecticidal fog applicator, usually referred to as 'Tifa,' is probably the most widely used commercial fog generator; it uses a stream of hot air to convert the insecticide solution to fog. Its operation can be understood by reference to Fig. 1. A constant volume of air from a Rootes-type blower enters the contra-flow combustion chamber *B* at *A*. The air is heated during its passage through the chamber by burning finely atomised petrol in it. The petrol is ignited by a continuously sparking plug. The hot air (temperature 900° to 1,100° F.) issuing from the combustion chamber passes to the specially designed fog distributor head *C*. The insecticide solution is pumped in at *D* at a constant pressure of 25 p.s.i. and the quantity passing to the head is accurately regulated by the valve *E*. In the fog head itself the insecticide is injected into the base of a stainless steel cup where it is swirled as a film round the inner surface by part of the hot air which enters through six tangential holes near the base of the cup. The insecticide is spun off the rim of the cup into the main stream of hot air passing round it and is ejected as a dense cloud of white fog. The mass median diameter of the fog particles can be varied over a range of ½ to 200 microns by varying the amount of insecticide solution passed to the fog head by the valve *E*, which is calibrated by the manufacturers; the more fluid passed, the larger the particle size. The amount of insecticide dispersed per hour varies from 16½ to 53 Imperial gallons. 'Tifa' is manufactured both in the United States and Great Britain. The British model currently produced is driven by a 6 h.p. engine and weighs 760 lb.

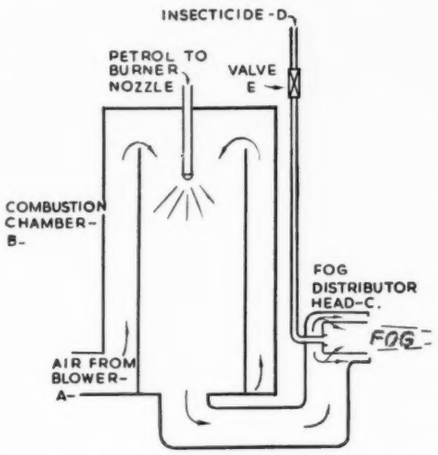


Fig. 1—Diagram illustrating the working of the 'Tifa' machine

The 'Swingfog' machine

Another fog generator using hot air has recently become available in this country. This machine, known as 'Swingfog,' is very simple in design (Fig. 2). It consists essentially of two concentric tubes. Hot air from a petrol-powered pulse-jet engine is ejected from the inner tube which is slightly shorter than the surrounding 'shroud' tube, and by venturi action draws cold air from the atmosphere through the shroud. The insecticide, forced from the container by pressure of air tapped off from the pulse-jet engine, is sprayed into the hot inner tube and converted to fog. The temperature of the tube is kept fairly constant at about 450° C. by the cooling action of the insecticide and

Fig. 2—Diagram illustrating the 'Swingfog' method of producing fog

TABLE I

Name of machine	*Weight lb.*	*Output of insecticide*	*Weight per g.p.h. output*	*Control of particle size*
		g.p.h.	lb.	
'Bes-kil'	660	31	20	Yes
'Tifa'	760	16.5–53	46–14	Yes
'Swingfog'	24	2–3	12–8	Yes
'Kyoritu'	144	3–6	46–23	No

the air passing through the shroud. 'Swingfog' is light enough (24 lb. without insecticide) to be easily carried by one man and is relatively inexpensive. The pulse-jet engine has no moving parts but requires a six-volt battery to start it. Its output of insecticide is 2 to 3 gallons per hour. The machine is now fitted with a valve allowing the particle size to be varied.

The 'Kyoritu' machine

The fact that insecticides can be converted to fog by atomising them into the exhaust stream of internal combustion engines has led to the production of various home-made fog generators. The exact details of design depend on the displacement of the engine and a useful table giving the necessary information has been reproduced in a recent American handbook.[1] The Japanese fogging machine 'Kyoritu,' to which further reference will be made later, is essentially a commercially produced machine of this type.

The essential features of the above fog generators are summarised in Table I.

Formulations for fogging

A basic fact about fog generators is that the insecticide must be dissolved in oil in order to produce a fog; insecticides dispersed in water cannot create a fog but are emitted as mists. Most of the common insecticides, including pyrethrum, DDT, BHC, chlordane, toxaphene, aldrin and dieldrin, can be dispersed as fog. A variety of oils are used to dissolve the insecticides, the choice depending on the insecticide to be dispersed, the pest to be destroyed and the type of infestation. The oil carriers usually used for fogging trees are kerosene and diesel oil. The insecticide can be dissolved directly in the oil, but insecticide concentrates formulated for fogging, like 'Deestan' and 'Hexastan'* which contain DDT and BHC respectively, have much to recommend them since methods and materials used in their manufacture can enhance the effectiveness of the fog produced.

Fog generators are designed so that the insecticide is in contact with the heat for the shortest possible time, but even so, some decomposition may occur depending on the nature of the oil solvent.

*Manufactured by the Standardised Disinfectants Co.

Effect of weather on fogging

Weather conditions in forests are generally more favourable for fogging than over open country and allow the fog to rise to the crowns of the trees and linger there long enough for particles to impinge on exposed insects and to leave an appreciable deposit of insecticide on the foliage. Nevertheless, careful study of weather conditions is always necessary to obtain the best results.

The direction of the wind in a forest is in the same general direction as the wind above the canopy, but the velocity falls rapidly between the top of the canopy and the forest floor. The heavier the canopy the greater the decrease in velocity. Wind speeds greater than 2 m.p.h. below a moderate to heavy forest canopy are not very frequent. In the open, inversion conditions usually occur between sunset and sunrise so that area foggings for mosquito and fly control are usually done at night to achieve the best results. Under a fairly heavy tree canopy the situation is reversed and lapses develop at night and inversions during the day. Under a moderate canopy inversion conditions will occur at the beginning and end of the day with ground lapses at midday. Under a thin canopy lapses and inversions will follow much the same pattern as in the open.[6]

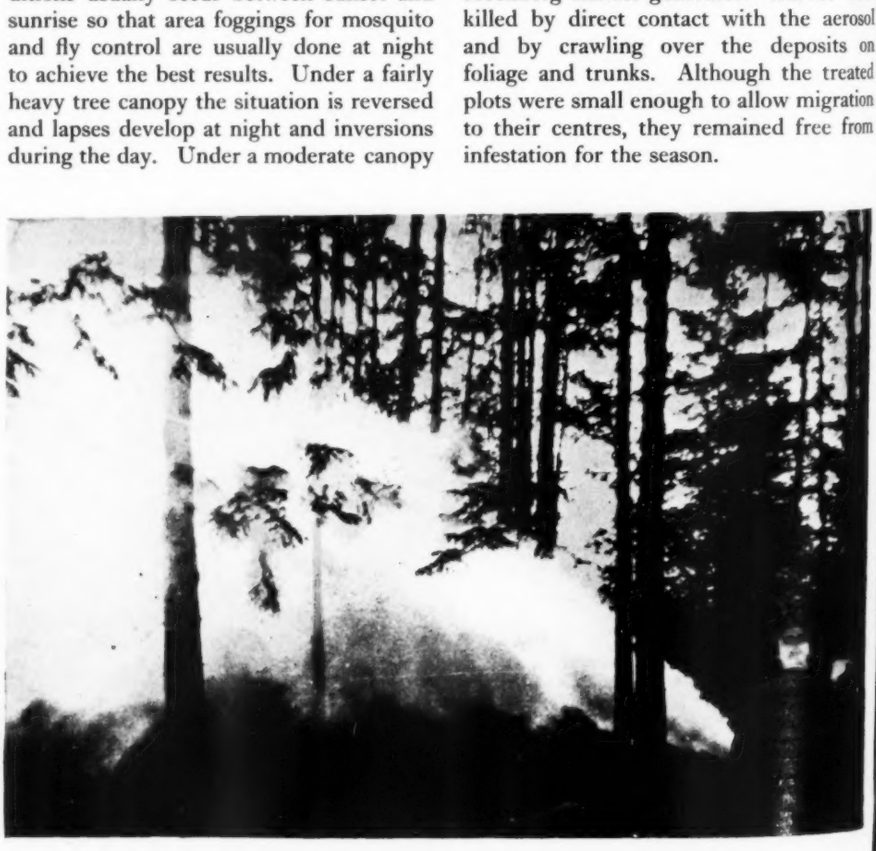
Gypsy moth control in U.S.A.

The first successful published work on fogging for control of a forest pest was carried out against Gypsy moth, *Lymantria dispar* L., infesting oaks using a Hochberg-LaMer generator, the forerunner of the 'Bes-kil' machine.[7] The Gypsy moth proved an excellent subject for tests. For several hours after fogging the affected larvae spin down on threads and the area affected by fog can thus be easily delimited.

The influence of the weather on the behaviour of the fog was noted. Positive air movement in one direction above the canopy was required, a 10 m.p.h. wind above the canopy being optimum. This gave a general downward movement in the forest with turbulence which distributed the fog throughout the foliage.

Fog applied during light rainfall or after heavy rain appeared to be as effective as when applied during dry weather.

With fog of particle size 12 to 20 microns complete control was obtained for distances of 250 to 800 ft. from the Hochberg-LaMer generator. Larvae were killed by direct contact with the aerosol and by crawling over the deposits on foliage and trunks. Although the treated plots were small enough to allow migration to their centres, they remained free from infestation for the season.



Nun moth control with 'Tifa' fogging in a Bavarian forest

The method of mounting the ' Tifa ' machine during nun moth control operations

Some tests were also carried out by applying fog to individual trees. It was found possible by taking advantage of the tendency of fog clouds to rise vertically upwards on dead calm days, to envelop completely the foliage of trees—even those with a very large spread. By using a high velocity blower to direct the fog trees could be covered very quickly. Effective reduction of the Gypsy moth population of the trees was obtained.

Nun moth control in Germany

In Bavaria, the 'Tifa' has been used with great success to control another serious pest, *Lymantria monacha*, the Nun moth.[4 12 13] The pest threatened some 2,500 acres of forest in the Weiden district. After preliminary tests had shown that 0.5 kg. per hectare DDT dispersed as fog gave nearly 100% kill, the infested forest area was fogged, using a solution of DDT (10%) in kerosene. A rate of 0.8 to 1.0 kg./h. was used in practice to allow a margin of safety.

The ' Tifa ' machine was mounted on a trailer drawn by a half-track vehicle which could take two drums of insecticide and an operator for the machine. The machine moved at 1 to 3 m.p.h. and 120 to 150 acres per day were treated. The fog travelled evenly through the forest, enveloping it from ground level to tree tops. As a rule the fog was virtually 100% effective up to 200 yards from the machine. The best time for fogging was early morning and late evening. Winds over 5 m.p.h. prevented successful fogging.

The results of the treatment were checked by noting the incidence of the Nun moth larvae on the trees and by estimating the excretion rate of the feeding larvae before and after fogging. The death rate two or three days after fogging varied between 98% and 100% and fell only in isolated cases to 90% and below where, owing to difficult terrain or climatic conditions, the rate of fog application was insufficient.

Fogging proved much cheaper than either motor dusting or aeroplane spraying. Less insecticide was used and less labour and organisation were needed. Some areas, because of their height or density, cannot be treated by dusting. In fogging, unlike dusting, little insecticide falls on the forest floor and interferes with the insect fauna there. The cost of spraying from the air is high because of the long approach from airfields and the high petrol consumption and depreciation of the machines. The relative costs of fogging, dusting and aerial spraying are in the order of 30, 60 and 100 DM/hectare respectively.

Control of elm leaf beetles in New York and Paris

During a series of experiments on the control of the elm leaf beetle, *Galerucella xanthomelanea* Schrank., carried out by the New York Agricultural Experiment Station, ' Tifa ' was used to fog elm trees. In one experiment a Chinese elm, 30 ft. tall, was fogged using 2 U.S. gallons of a 5% solution of DDT in fuel oil. High kills of adults and larvae were obtained.[3]

In Paris, trees in the boulevards and squares have also been fogged with BHC to control an attack of elm leaf beetle. The operation, which was carried out by a commercial pest control operator using a ' Tifa ' machine, was a notable success.

Control of Japanese beetles in Maryland

In the United States, fogging has been used to control Japanese beetles, *Popillia japonica*, which had become a serious pest in Maryland cities. In these cities, fog generators are used for the control of flies and mosquitoes and experiments were undertaken to determine the optimum conditions of insecticide concentration, particle size and wind speed for efficient *Popillia* control. For trees and shrubs the fog was directed into the foliage, a 20% solution of DDT being dispersed at a particle size of 40 to 60 microns.[5]

Control of wattle bagworm in South Africa

The Wattle Bagworm, *Acanthopsyche junodi* Heyl., is the commonest and most destructive pest of wattle in South Africa. Infestations build up over a period of 5 to 7 years. In the final stages trees are completely defoliated and if complete defoliation occurs in two successive years many trees die. The insect is native to South Africa, its natural host plants being acacia bushes.

The most opportune time for applying chemical control measures is at the earliest stage of infestation when mobile equipment can be used from existing firebreaks and headlands. The first experiments were carried out with a ' Tifa,' the machine being mounted on a trailer drawn by a jeep. In later experiments the machine was mounted on the jeep itself.

The insecticides used were BHC at concentrations of 2, 3 and 4% gamma isomer in dieseline and 2.5, 5 and 10% toxaphene in the same solvent. The average rate of application was 3 gallons per acre with the machine travelling at 4 miles per hour.

High mortalities were obtained (up to 100%) in the first four instars, but decreased in later instars although control remained satisfactory provided good cover was obtained. The length of time for which the fog stayed in contact with the foliage and the completeness and uniformity of its distribution proved most important. When these were good, 2% gamma BHC and 2.5% toxaphene gave good control. BHC acted rather more quickly than toxaphene, but the latter appeared to achieve greater ultimate mortality.

When the areas which had been fogged were examined five to seven months later it was noted that a further kill of 2.5 to 21.4% over natural mortality had occurred. Thus both BHC and toxaphene seem to remain toxic for some time.[10]

Cloudy, even drizzly, windless days proved most favourable for fogging as the fog hovered in the crowns of the trees and saturated the bags thoroughly. Sunny days, on the other hand, have the advantage that the bagworm is then feeding partly out of its bag and is thus more easily killed. The heat, however, causes upward thermal air currents and the fog rises quickly and cover is unsatisfactory.

Preliminary results of the effect of fogging heavily infested wattle with 3% toxaphene during the copulation and prehatching period have been reported and high mortalities of males and females were recorded. Another series of experiments carried out the following year confirmed these results.[11]

The Wattle Research Institute Report also describes experiments with the Japanese fogging machine 'Kyoritu.'[11] This apparatus, which has a total weight of 144 lb., is driven by a four-stroke single cylinder 2 h.p. petrol engine. Insecticide is pumped into the exhaust pipe of the engine where it is converted to fog, which is discharged by means of a high speed blower. Its output of insecticide is 3 to 6 g.p.h.

Using the 'Kyoritu' machine, experiments have been carried out to study the factors involved in fog control of bagworm. Although experiments are not yet complete some practical conclusions can already be drawn:

TABLE 2
EFFECT OF DISTANCE FROM MACHINE AND TIME OF EXPOSURE TO FOG ON MORTALITY OF FALL WEBWORM

Distance of webs from 'Swingfog' (Metres)	*Time of exposure to 'NL 5' fog (Seconds)*	*Effect on larvae (observed 24 hours after fogging)*		
		Dead	*Affected*	*Unaffected*
		%	%	%
1	5	70	30	0
	10	84	16	0
	20	100	0	0
5	10	64	36	0
	20	100	0	0
10	5	0	9	91
	10	0	38	62
	20	All larvae affected, a few already dead. None capable of recovery.		

(1) 3% gamma BHC or 5% toxaphene in dieseline solution give good kills of bagworm up to the third instar, providing good cover is achieved.

(2) Best results are obtained when fogging is done an hour or two after sunset and onwards through the night to 5 a.m. The average wind velocity must not exceed 5 m.p.h. The greater the humidity of the air during the operation the higher the kill obtained.

(3) To obtain satisfactory mortalities the insect as well as the food supply must be exposed to fog for not less than 10 seconds.

(4) A high mortality can be obtained up to 10 yards from the outlet of the 'Kyoritu' machine.

The 'Kyoritu' machine has the advantage of portability and cheapness, but has a rather low output and the particle size cannot be controlled. Particle size determinations with the 'Kyoritu' have been carried out, using four oils of different viscosities.[8] No significant difference in particle size was obtained with the different oils although there was some indication that the higher viscosity oils gave larger particles.

Apart from bagworms, froghoppers and adult cockchafers, *Eulepida mashona* have also been successfully controlled by fogging.

It is understood that 'Swingfog' generators are being examined by the Wattle Research Institute, although no results have yet been published. They will be looked for with great interest in view of the notable work being carried out at the Institute and the interest which has been aroused by the 'Swingfog' machine elsewhere (*cf.* WORLD CROPS, October, 1952, p. 337, and *The Commercial Grower*, January 8, 1953, p. 64).

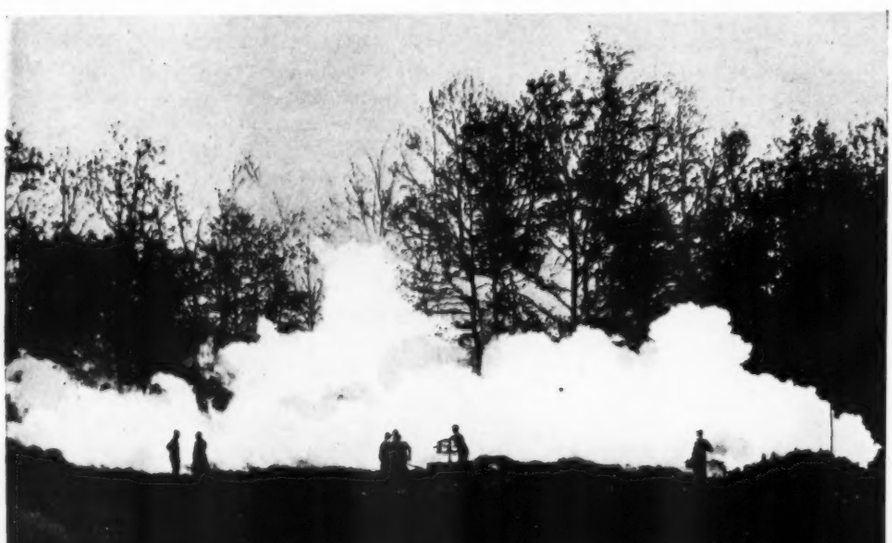
Experiments with fall webworm

Promising results have been obtained using 'Swingfog' against the fall webworm, *Hyphantria cunea*, by the Bundesanstalt fur Pflanzenschutz, Landwirtzschaft und Bakteriologische Versuchanstalt in Austria (private communication). It has been found that the fog penetrates the webs of the larvae very effectively. Mortality depends on how close the web is to the machine and on how long it remains in the fog (Table 2). The formulation used was a very concentrated Geigy solution (NL5) containing 15% DDT and 5% gamma BHC. The *Hyphantria* larvae were in the fifth instar.

Conclusions

Fog generators, though generally impractical as a means of controlling agricultural pests, have proved highly effective against a number of moth and beetle pests defoliating trees. Froghoppers can also be controlled by fogging. The use of fogging should always be considered along with dusting, mist-blowing and aerial spraying whenever application of insecticides to trees is being planned.

The mortality obtained with fog generators will depend on the distance of the pest from the machine, the length of time the fog is in contact with the pest and the



'Swingfog' units being used in a German forest

host plant, and the evenness and completeness with which the fog envelops it. Time of contact and completeness of cover will in turn depend on the weather conditions and these must be carefully studied and taken fully into account. The size of the fog particles is also important and it should be possible to alter this so as to obtain the maximum effect with the minimum expenditure of insecticide.

The choice of equipment for the machines at present available will be dictated in any given case by the size of the infested area, the men and money available, the terrain (in particular the presence or absence of roads and rides) and other local conditions. There appears to be a definite need for a fog generator intermediate in size between 'Bes-kil' and 'Tifa' on the one hand, and 'Kyoritu' and 'Swingfog' on the other. Such a machine should have as high an output as possible for its size, simple and rapid control of particle size and fog direction, low weight, compact construction, and as low a price as is compatible with good design and rugged construction. It should be simple to operate, reliable in use, and easy to maintain.

A 'Tifa' machine fogging wattle

When new models of fog generators are designed all these factors must be taken into account. The proper design of fog machines, perhaps even more than of other machines for applying insecticides, demands full and close co-operation of engineer and entomologist with both keeping the user's point of view, be he forester or sanitarian, well in sight.

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Australian Farming Notes

(From Our Australian Correspondent)

Australia and the wheat pact

The Federal Cabinet will introduce legislation in the next session of Parliament to make easier Australian ratification of the International Wheat Agreement. Recent cabinet discussions covered all the recent proposals of the Australian Council on the future of Australia's wheat industry. The decisions were: Legislation next session to ensure the continuance of the Australian Wheat Board during the 1953-54 season and, if necessary, for International Wheat Agreement purposes, for the following two crops. This orderly marketing arrangement will operate even if the new wheat stabilisation plan does not eventuate. The Federal Government believes that a uniform selling price should operate within Australia for all home consumption sales of wheat and that the price so determined, or the established cost of production, whichever is higher should apply. The Commonwealth is prepared as part of an acceptable wheat stabilisation plan to guarantee growers the found cost of production up to 100 million bushels of export wheat in each year of the plan. The Minister for Commerce (Mr. McEwen) said that a special committee would advise the Government of the cost of production. Another committee would examine all aspects of the proposed guarantee, including the appropriate rate at which growers should contribute by export tax to support the guarantee. Mr. McEwen said that all matters dealing with the stabilisation would have to be settled at the next meeting of the Australian Agricultural Council. This would allow time for a ballot of growers and the necessary legislation through all Parliaments so that the plan could operate for the sale of the next harvest. The responsibility for deciding the home consumption price was a State matter, Mr. McEwen said. Before the orderly marketing arrangement could operate through the continuance of the Australian Wheat Board, State Governments must pass complimentary legislation after or during the next Federal session. One State had already agreed to do so and other State Governments were giving the matter urgent attention, he said, adding that the Commonwealth wished to ratify the International Wheat Agreement, but felt that it would be impracticable unless there was an orderly wheat marketing plan.

Tea in New Guinea

An overseas tea expert has reported favourably to the Commonwealth Government on the prospects of growing tea in Papua and New Guinea.

The expert visited the territories earlier this year and reported that provided a suitable technique is followed, there seems no reason why yield results similar to those in Ceylon and India should not be possible. He says that there are great areas of undeveloped land in New Guinea and Papua suited to tea production.

Government interest

The Government believes that the tea yield there could be as much as 1,000 lb. an acre. It is trying to encourage individuals and companies, both Australian and overseas, to take up tea growing there. A few private interests have already planted some small crops, while the Government is growing tea at Garaina, in the mountains south of Lae.

It bought 395 acres there in 1948 and about 70 acres are now under cultivation. The object of the plantings is to provide seed for new estates and also to provide economic and technical information to commercial tea producers in the future. Seed produced at Garaina should produce sufficient material to plant 400 acres annually.

The Clove Industry in Zanzibar and Pemba

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In our second volume, pages 143 and 198, we published an article by Mr. R. O. Williams on the Zanzibar clove industry. Since then, the disease, and particularly the "Sudden Death" disease by which the clove tree in Zanzibar and Pemba was attacked, have been investigated and the cause elucidated. In commenting on this, some sources have apparently erroneously assumed that the industry was in danger of early extinction. No account was taken of the comparatively small effect which the various maladies have had on the overall yield of cloves nor has full account been taken of the large amount of work carried out over a long period to ensure the maintenance and rehabilitation of the clove industry. This deficiency the present article endeavours to remedy.

DURING the period 1948 to 1953, a team of scientists has been engaged in Zanzibar and Pemba investigating the cause of a disease of clove trees known as 'Sudden Death'; so named because of the rapidity with which affected trees die. Their investigations have led to the recognition of other diseases of which the most important is known as 'Dieback.'

Valuable as these investigations have been, they have led to widespread publicity which, to people who know little or nothing of Zanzibar and Pemba, has represented a rather one-sided picture of the present state of the clove industry. There is no doubt that an impression has been created in many people's minds that the clove industry of these islands is rapidly dying out and, from the long-term point of view of production and marketing, this has not been very helpful. It is with the object of correcting this impression that this note has been written.

Sudden Death disease

The condition termed 'Sudden Death' has been recognised and recorded over a long period of years although its cause was not known. Specialists have investigated and reported upon it from time to time since the year 1912 and, although the disease is serious, there is no doubt that heavy losses of trees from other causes, particularly drought, have in the past often been confused with 'Sudden Death.'

Losses of trees in Zanzibar Island have been very heavy, particularly during the last 20 years or so. In 1947, it was estimated that within the previous 12 years, 500,000 trees had died, out of a total population of some 1½ million trees. It has, however, to be borne in mind that most of these trees had been planted soon after the 1876 hurricane which destroyed more than half the trees on Zanzibar Island and many were thus no longer in their prime.

Efforts to maintain production

Although the nature of 'Sudden Death' disease remained obscure, there is ample evidence to prove that strenuous efforts have been made, and fairly successfully as it will be shown, to keep up production in these islands. In the years 1922 to 1926 a bonus was paid by the Government for planting seedling clove trees, and each year since then, with few exceptions, the Department of Agriculture, with financial assistance in later years from the Clove Growers' Association and from Colonial Development and Welfare Funds, has grown and distributed seedlings in Zanzibar and Pemba in large numbers, either free or at approximately one-sixth of the cost price. Since the year 1935, 1,428,622 seedlings have been distributed in Zanzibar Island alone and 738,368 in Pemba. In the establishment of young seedlings many die and those which grow take many years to come into full production. Although the tree population and the area under cloves in Zanzibar have been reduced, those of Pemba have been increased by the replanting of diseased areas and by extending clove cultivation into new areas. With the passing of the years and the extensive plantings which have been carried out, the proportion of young trees in the total population is increasing, a not unwelcome feature for the future of the clove industry.

An examination of Zanzibar plantations undertaken in 1940 showed that 18% of

Regeneration of a plantation in which the old trees had succumbed to 'Sudden Death' disease. The new trees are now seven to eight years old (an illustration of this planting taken at the end of 1949 appears in Vol. 2, p. 200, of 'World Crops')

Clove trees seven to eight years old planted 21 ft. by 21 ft. apart. Cloves growing on this land previously were destroyed by fire

the trees were less than 13 years old. Annual plantings have been on an increased scale since that date, and a very large percentage of the existing trees in Zanzibar Island and a fair percentage in Pemba can be placed in the age group of 1 to 26 years.

In Pemba, 'Sudden Death' is generally not so active and is normally confined to small groups of trees, but large areas are due for rehabilitation if the age groups for maximum production are to be maintained. A great deal is being done by means of the continuous annual supply of trees as stated earlier, so much so that a rehabilitation scheme with bonus payments based on a minimum area of one-fifth of an acre to be regenerated in any one block was refused by the growers on the grounds that too few people would benefit. Whether that statement is acceptable or not, it does point to the fact that there are no large areas in Pemba, suitable for cloves, which remain unplanted. There is no doubt indeed that the large number of trees, of varying ages, in Pemba Island is a bright feature of the industry, as also of the countryside.

Government action

The Government, the Clove Growers' Association, and the producers are not maintaining a complacent attitude as regards the maintenance of the major industry of these two islands. The research team has now concluded its investigations, but the Department of Agriculture is continuing with a most important programme of agricultural experimentation and demonstration. Following investigations by the research team into the causes and control of dieback, the Department of Agriculture has undertaken experiments to test the practicability and suitability of the measures which have been proposed for its control. Dieback is a serious disease of the clove tree which has been responsible for heavy loss of crop for many years. It is the considered view that if control of this disease alone could be accomplished the yields of cloves in both islands would be considerably increased. The control methods advocated consist of pruning and tree surgery, but whether these will be either practicable or economic has yet to be proved. In the case of old trees many are beyond treatment and it is on young trees that control measures should be concentrated.

An important line of investigation following on the work of the research team is to study the possibility of arresting the progress of 'Sudden Death' in active outbreaks. Another is to try to discover conditions under which clove seedlings have been established on land recently devastated with 'Sudden Death' without their subsequently being affected with 'slow decline.' This is a state of debility about which little is known and which very commonly affects young trees soon after they have reached the age of 10 to 12 years. The visible symptoms are thought to be an expression of an unhealthy root system which may be connected with infection by a fungus, *Valsa*, and to which drought is possibly a predisposing factor.

Stepping up production

A programme to step up the present production of seedlings has been suggested by growers in Pemba, and as a result the Clove Growers' Association has recently granted an additional £10,000 to be spent over a period of five years for the production of free seedlings by the Department of Agriculture. In Zanzibar, besides the seedlings customarily produced with the aid of Government and Clove Growers' Association funds, the Association is financing a small rehabilitation scheme to provide free seedlings and bonus payments to cover the cost of new plantings and their upkeep over a five-year period. From the growers themselves, heavy demands for seedlings to replace old trees continue.

Conclusion

In conclusion, it is interesting to examine the effect of the losses of old

A clove plantation of 1,400 trees, 15 years old, 24 ft. by 24 ft. Considerable care has been taken when picking the crop from these trees so as not to damage them

trees in both islands on clove production over a large number of years. This examination is complicated by the erratic yields which are normal to the clove. As an example of the wide range of fluctuation which occurs, the crop for the seasonal year ending June, 1953 is likely to be the smallest of the century, and that for 1953-54, the picking of which will soon commence, one of the largest crops on record.

Table I shows the annual yields for both islands for the seasons 1942-43 to 1951-52; Table 2 shows the yield in ten-year cycles and the average annual yield for 50 years.

TABLE I
YIELD OF CLOVES IN SEASONAL YEARS

Season	*Zanzibar tons*	*Pemba tons*	*Total tons*
1942-43 ..	625	3,495	4,120
1943-44 ..	4,116	12,144	16,260
1944-45 ..	3,132	7,178	10,310
1945-46 ..	414	2,517	2,931
1946-47 ..	2,661	14,443	17,104
1947-48 ..	483	4,390	4,873
1948-49 ..	1,277	4,859	6,136
1949-50 ..	2,404	6,723	9,127
1950-51 ..	2,478	16,903	19,381
1951-52 ..	717	4,531	5,248
Total ..	18,307	77,183	95,490

TABLE 2
YIELD OF CLOVES IN TEN YEAR CYCLES, AVERAGES IN TONS

Period of ten years	*Zanzibar tons*	*Pemba tons*	*Total tons*
1902-03 to 1911-12	2,000	5,238	7,238
1912-13 to 1921-22	2,245	5,497	7,742
1922-23 to 1931-32	3,075	7,147	10,222
1932-33 to 1941-42	3,061	7,974	11,035
1942-43 to 1951-52	1,831	7,718	9,549
	12,212	33,574	45,786
Average 1902-03 to 1951-52	2,442	6,715	9,157

From these tables it may be gathered that the peak clove production of Zanzibar and Pemba averaged 11,035 tons per annum during the ten-year period 1932-33 to 1941-42. During the last ten-year period the average yield has declined from the peak by 1,486 tons per annum, or 13.4%. This was mainly due to a decrease in production in Zanzibar Island.

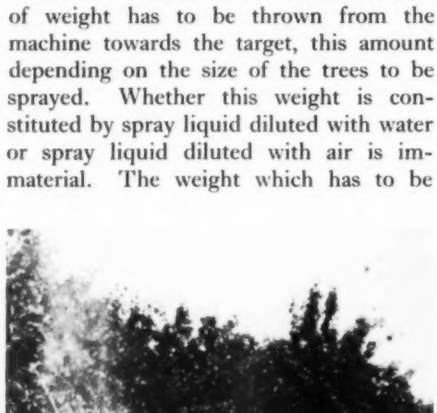
A comparison of the annual average yield for the half-century with that of the last ten-year period shows that Zanzibar production has decreased by 25%, Pemba has increased by 13%, and the total production of the Protectorate has increased by 4%. The island production may now be taken at an average figure between 9,000 and 10,000 tons per annum.

Low Volume Spraying in the Orchard

ON ground crops, low volume spraying has been established for several years, bringing about a considerable saving in spraying costs as a result of smaller quantities of spray liquid having to be towed through the crops.

In orchards, however, it is necessary to use high volume spraying because the spray particles thrown against the tree have to have enough initial volocity and weight to reach a distance of up to 10 yd. When using very finely atomised spray the momentum of these spray particles is insufficient to overcome the air resistance, and they will travel a few feet at the most after which their momentum becomes exhausted and they drift with the prevailing wind. The advantage of using very small droplets, however, is firstly that no drip-off occurs, resulting in a saving of approximately 30% of chemicals and, secondly, that the spray dries so quickly on the leaves that no scorch occurs. Furthermore, an infinitely better coverage is achieved with a number of small droplets because one 500 micron droplet, the usual size in high volume spraying, contains as much spray liquid as 125 100 micron droplets, which is the average size of particles produced by the Micron Sprayer.

After several years' study of these problems by Clean Crops Ltd., the following conclusion was reached: A certain amount of weight has to be thrown from the machine towards the target, this amount depending on the size of the trees to be sprayed. Whether this weight is constituted by spray liquid diluted with water or spray liquid diluted with air is immaterial. The weight which has to be thrown towards the target varies from 1,000 to 4,000 lb. per acre, according to the size of the trees, *i.e.* equal to 100 to 400 gal. of spray liquid used in high volume spraying.



The 'Micron' sprayer in use

Output

The Micron Sprayer, orchard type, was designed on these lines and two prototypes have been tested for one season. The production model incorporates some slight modifications suggested by users from their experience. This model atomises the liquid in a spinning cup, needing no high pressure nozzles, and produces more-or-less even sized particles. The recommended spray output through the rotary nozzle is 1½ to 2 gal. of concentrated spray liquid per minute, to which is added 2,000 cu. ft. of air (weighing 155 lb. under average conditions), giving a total weight ejected by the nozzle of air and liquid combined of approximately 170 lb. per minute. This equals in weight 17 gal. of spray liquid in high volume spraying.

Description of the machine

A 420 c.c. B.S.A. Industrial engine is directly coupled to a paddle-type fan delivering approximately 2,000 cu. ft. of air through a 6 in. diameter nozzle. The air stream passes through a duct from the fan to a turn-table on ball bearings, giving free horizontal movement, and a short flexible tube mounted on a 45° bend can be swivelled by means of a lever from horizontal to vertical without any effort.

A V-belt drives a rotary pump delivering 30 gal. of spray liquid per minute, of which 1½ to 2 gal. are fed to the atomiser and the rest is fed back into the 50-gal. tank, thereby giving a strong agitation.

Three cocks regulate the feed to the atomiser and a trigger valve provides instantaneous shut-off of the spray liquid. The spray liquid is fed into the hollow cone of the shaft from where it is passed in to the rotary cup which ejects the finely atomised particles. These particles are swept up by the passing air stream and carried towards the target.

A nylon filter in the supply line will withstand any corrosive action of the spray liquid.

A canvas seat is fixed so that the operator sits as low as possible, and a small steel canopy is provided over the operator's head to protect him from low hanging branches.

The whole unit, with the exception of the canopy, is 4 ft. in height, 9 ft. in length and 3 ft. 6 in. in width. The weight of the unit, including 50 gal. of spray liquid, is 10 cwt.

Agricultural Conditions in Sicily

Agricultural production and agrarian conditions in the lovely island of Sicily have long been below the standard which prevails in other parts of the Italian domain. The position and the steps which are being taken to improve matters are described in the article below based upon a recent lecture in Palermo by Ing. Giuseppe Orcel, Director of the Cassa del Mezzogiorno, the organisation charged with the improvement of rural conditions in Sicily and Southern Italy.

SICILY is the largest of the 19 regions into which Italy is divided. It is inhabited by some 4,450,000 persons (nearly 10% of the whole population of Italy) and is thus one of the most populated regions in the country. There are 172 inhabitants per square kilometre and in this respect it holds the fifth place in Italy, coming after Campania (317), Lombardy (273), Venetia (208) and Latium (196).

About 46% of working Sicilians are engaged in agriculture and, according to official figures, 2,439,000 hectares, or 92.2% of the whole area of the island, are devoted to this occupation. Apart from the unproductive areas (5.1%) very little land has been neglected by Sicilian farmers and foresters.

Agricultural production

The productive lands of Sicily constitute about 8% of the national total; they are not, however, exploited fully. The output of some Sicilian crops is impressive. For example, in 1951 the production of certain crops was as follows:

	Tons	*Total of National Output (aprox.)*
Lemons	268,000	90%
Mandarines	68,400	80%
Oranges	295,700	60%
Almonds	61,300	59%
Fresh broadbeans	62,000	44%
Dried beans	165,000	36%
Hazel nuts	11,400	34%
Olives	420,301	25%
Tomatoes	242,800	20%
Olive oil	66,000	18½%
Fennel (1952)	29,720	16%
Fresh peas	20,900	15%

On the other hand, the output of such important crops as wheat (677,000 tons, or 10%), oats (30,560 tons, or 7.8%), wine (4,524,000 hectolitres, or 10%) is far from impressive, while the production of many other crops, such as maize (3,200 tons, or 0.13%), kidney beans (4,600 tons, or 1½%), potatoes (69,000 tons, or 2.9%), cabbage (26,600 tons, or 4%), tobacco (400 tons, or ½%), hay (1,355,000 tons, or 4%), apples (10,800 tons, or 1.4%), pears, peaches, cherries, prunes, etc., is decidedly poor.

The background

To understand this situation we must realise that the conditions under which agriculture is carried out in Sicily are quite different from those in Northern Italy where the farmer has much more water, fertilisers and machinery at his disposal and where much of the land consists of large flat stretches convenient to till. In Sicily, the countryside is mostly hilly and while some parts of it are highly fertile, most of the soil there is poor.

One of the typical new farmsteads in the reclaimed areas in Sicily

For this reason the value of the production per person engaged in agriculture is much lower than in Northern Italy, while the per capita income is very low. The pre-war figures show that (taking the Italian average at 100) the average per capita income in Sicily was only 67 points, while in Piedmont it was as much as 149 points and in Liguria and Lombardy 140 points. In other words, while his Piedmontese brother earned 3,870 lire (about 43 English pounds in those days) the Sicilian had to content himself with 1,736 lire (about £19 6s.). Things have not improved much since those days, and, in fact, current statistics show that the average Sicilian today eats 60.8% less meat, 37.9% less sugar and 66.8% less milk than the average Italian (and it is no secret that an average Italian's rations of these three commodities is none too exaggerated). The low earning capacity of the average Sicilian is made worse by a high cost of living. In fact, the Sicilian Institute of Statistics reports that in December, 1952 the ' index ' of the cost of living in Sicily reached 107.7, while the same index for the whole of Italy showed only 105.5.

Causes of depression

This situation is by no means new; it has in fact been repeatedly stressed by numerous authorities for many years. Many factors have been held responsible for it, including the apathy and backwardness of the population, the lack of roads, the shortage of water, the faults of the large Sicilian landlords and of the North Italian industrial magnates, and the indifference of politicians. All such explanations are true to a certain extent, but it would be hard to discern which of these factors are causes and which are consequences. A farmer is apt to get apathetic if there is no water, no machinery, no roads and no credit at his disposal. In other countries Sicilians are active and resourceful citizens. The political aspects of the situation are outside our province, but it can be safely stated that while the farmers

of Northern Italy have received for long the benefits of up-to-date agronomics, their Sicilian brethren have not. The shortage of irrigation water is an obvious example. At present, the irrigated area in Sicily totals only 90,000 hectares, or only 3.8% of the total cultivable area of the island. By contrast, even in 1942, 23.7% of the cultivable area in Northern Italy was irrigated! Even as regards drinking water, the situation is very bad. Indeed, out of the 370 communes into which Sicily is divided, only 37 have an adequate supply of drinking water, 275 have an inadequate supply, and 58 have none at all.

Livestock

Owing to shortage of water and poor crops of fodder, livestock in Sicily is scanty. The latest statistics show that there are only 276,000 bovines and 126,000 pigs in the island, representing only 3% of the national total. The situation is a little better as regards sheep (737,000, or 7%) and goats (309,000, or 12%). It is, however, such hardy animals as mules and donkeys that help the Sicilian population to make out. In fact, about 50% (200,000 head) of all the mules and 18% of all donkeys (142,000 head) in Italian territory exist in Sicily.

Ameliorative measures

It is to deal with this situation in Southern Italy in general and in Sicily in particular that the *Cassa per il Mezzogiorno* has been instituted. This institution, which might suitably be termed the 'Southern Italy Fund,' was created in 1950 to finance a series of schemes to improve the economic situation in the depressed areas of Italy. To achieve this on a really tangible scale, an expenditure of 1,000 milliard lire was budgeted for in the first 10 years. Subsequently, this amount was increased to 1,280 milliard lire spread over 12 years. The destination of these additional 280 milliard lire has not yet been decided, but out of the 1,000 milliard about 22½% (225.5 milliard) has been assigned to Sicily. This amount will be spent under the following headings:

- Land reclamation and similar improvements: 85 milliard, or 37.7%.
- Anti-erosion measures and terracing on mountains: 24 milliard, or 10.7%.
- Agrarian reform: 80 milliard, or 35.5%.
- Aqueducts: 11 milliard, or 4.9%.
- Roads: 17.9 milliard, or 7.5%.
- Tourism (hotels, improvements in roads, etc.): 7.5 milliard, or 3.3%.

The most striking feature of this budget is the fact that the lion's share, 84%, of the expenditure has been assigned to schemes benefiting agriculture directly. This also holds true for the whole policy of the Southern Italy Fund, but for the rest of Southern Italy the proportion allocated to agriculture is only 75%. Incidentally, it should be noted that no expenditure on industrialisation is included under this fund since this has been provided by other schemes.

A new road in Sicily

Programmes of expenditure

The most important item in the programmes of the scheme is land reclamation. According to the calculations of experts, some 1,250,000 hectares of land in Sicily require improvement. To carry out such a colossal job over 200 milliard lire would be needed, and as only 85 milliard are available, the programme of work under the fund has been limited to 831,000 hectares included in schemes already on schedule. This means that only about two-thirds of the necessary work will be done, but it will be, nevertheless, a considerable advance. The agricultural areas of Sicily presents the following features:

- Area of land needing improvement: 1,250,000 hectares, or 52% of the total.
- Area of land that can be considered satisfactory: 1,189,000 hectares, or some 48% of the total.

It is anticipated that at the end of 10 years the situation will be as follows:

- Area of land needing improvement: 419,000 hectares, or about 17%.
- Area of satisfactory land: 2,020,000 hectares, or about 83%.

The value of the fund's activity is not limited to the jobs actually carried out. It is obvious also that it is most important as a stimulus and incentive to further efforts, since increase in the prosperity of a substantial number of citizens is bound to react favourably upon the prosperity of the rest of the community and increase its capacity for private enterprise.

A horn announces the arrival of water

Other activities

The schemes of the Southern Italy Fund include also provision for irrigating some 100,000 hectares of land. This will double the irrigated area. The work planned under this head includes the 'correction' of the beds of streams, drainage canals, etc.

Twenty-four milliard lire are destined for expenditure on schemes in mountainous districts. Such schemes consist essentially of terracing the slopes of mountains to prevent soil losses by erosion.

This work often involves, of course, 'guiding' torrents and conveying their waters to places where they would be of use.

Drinking water supplies

As regards the supply of drinking water, Sicily is really well watered and it is merely a question of adequate effort to make supplies circulate. At present, streams with a total capacity of about 4,500 litres per second are utilised for this purpose and the new schemes envisage expending a further 3,000 litres per second. This will improve the situation considerably and as the total number of springs in Sicily not yet tapped are estimated to yield about 6,000 litres per second it is to be hoped that ultimately the Sicilians will no longer have a shortage of drinking water.

Roads

A few words should be said about roads. Roads are not exactly an 'agricultural' item, but farmers must have roads to transport the produce to market. Sicily is poor in roads; indeed, the official figures for 1951 show that there are only 335·3 km. of roads per 1,000 sq. km. of territory. This, apart from Sardinia, is the lowest figure in Italy, and about 40% less than the Italian average (566.9 km. per 1,000 sq. km. of territory).

Today, there are in all some 9,959 km. of roads in Sicily and it is calculated that a further 1,250 km. are urgently required. A detailed programme involving the expenditure of some 22½ milliard lire was worked out some time ago, but after a careful study the council of the fund came to the conclusion that many of the suggested new roads were not really needed and the programme was cut down to 10.3 milliard lire for new roads (580 km.) and 7.62 milliard lire for improvements to existing roads (1,624 km.). As a result of these schemes, the proportion of 'dustless' (tarred) roads in Sicily will rise from 34% to 70%.

A drainage system beyond Disneri Dam in the basin of the River Gela in Southern Sicily

Conclusion

Limitations of space prevent the complex question of agrarian reform being dealt with here; it would require a separate article. It may be appropriate, however, to give some indication as to how far the Southern Italy Fund has progressed in the accomplishment of its programme. The latest figures available cover the period from the time when it actually began to operate to the end of May last, *i.e.* 27 months in all. During this period the total amount provided under the heading of Land Reclamation and Erosion Prevention was 109 milliards of lire. The schemes so far approved total in value 28 milliards of lire, of which contracts have been signed for over 24 milliards of lire. In spite of the fact that all the schemes under contract have not yet been completed, the Southern Italy Fund has made a very good job of the tasks assigned to them; much experience has been gained, as is to be expected, and when the preliminary studies and investigations have been completed the rate of progress will be considerably accelerated. The prospects seem to be that as a result of these operations the sunny island of Sicily may in the end become once more a large producing area.

A new bridge over the Gela River

Queen Elizabeth Forest

For generations the Hills of Nazareth have been a stony wilderness. In Biblical times, Nazareth had been the centre of a rich agricultural area, but with the vanishing of the primaeval forests whose remains had clothed the hilltops, the fertile fields, deprived of their shelter, had been gradually eaten away by erosion. Here only flocks of goats could flourish, continuing the destruction of the remaining shrubs and trees on the hillsides.

The reafforestation of the upper slopes of the Nazareth hills is the first step which must be taken if the soil of this region is to be reclaimed and restored to fertility. The Jewish National Fund has allocated 1,000 dunams of land in the Hills of Nazareth as the site of the forest which will be planted by the Jews of Great Britain and the Commonwealth to commemorate the Coronation of Queen Elizabeth II.

The Queen Elizabeth Coronation Forest will be west of the Washington Forest and the King Albert of Belgium Forest, and east of the King George V Jubilee Forest. These forests are already well developed, so that the Queen's Forest will complete the foundations of the reclamation work which must be done to restore the fertility of this once rich area.

Degeneration of South African Citrus Clones*

PROF. P. C. J. OBERHOLZER
Agricultural Research Institute, Pretoria

In WORLD CROPS, *vol. 4, p. 64, we published an article on the virus disease of citrus plants known as 'Tristeza.' Since then the occurrence of this and other diseases in South Africa has continued to arouse anxiety. The position in this regard is reviewed below in an article taken from Farming in South Africa, the official organ of the Union Department of Agriculture.*

TREMENDOUS losses, including the death of millions of bearing citrus trees in South America, have been experienced in the past years in most of the citrus-growing regions of the world. The so-called 'Tristeza' virus disease in orange trees is chiefly responsible for this calamity, especially in sweet oranges with the Bitter Seville as root-stock, and also in seedling lime orchards. Today we know that it was because of the above-mentioned virus disease that as early as 1904 the Bitter Seville had to be discarded as a root-stock for citrus fruits in favour chiefly of the rough lemon, which is fortunately highly resistant to this disease in most scion unions. The union of grape-fruit with rough lemon, however, does not show sufficient resistance, and it is generally believed that the so-called 'stem-pitting disease,' which has rendered almost 40% of the grape-fruit orchards commercially valueless, must be ascribed to the 'Tristeza' virus. Other virus diseases, and especially 'psorosis,' decidedly cause degeneration and in a few cases even actual loss of trees, although by far not to the same extent as 'Tristeza.'

Serious deterioration

In addition to virus-degeneration, serious deterioration has also been experienced during the past years in certain varieties of mandarins and smooth-skinned lemons. The precise nature of this decline is up to the present not known, but it is fairly certain that it cannot be ascribed to virus infection. Be that as it may, the fact remains that in South Africa important varieties of lemons (*e.g.* Eureka) and mandarins (*e.g.* Natal Tight Skin) have deteriorated to such an extent that their commercial life reaches 15 years at the utmost, in consequence whereof they can scarcely any longer be recommended for planting. Indeed, it is no exaggeration to say that it is only the sweet orange group, and particularly the Valencia variety, which does not as yet show form of clonal deterioration to a serious degree, unless, of course, the Bitter Seville is used as root-stock. The question may now be put: What steps can be taken to solve the above-mentioned problems successfully? We are, no doubt, faced with a series of intricate problems, but the following four trends of thought are suggested as a basis for satisfactory solution.

Suggested remedial measures

(*a*) As far as the 'Tristeza' virus is concerned, which must be considered an inseparable part of clonal citrus material in South Africa, the only remedy appears to be the planting of resistant graft unions, *e.g.* by making use of the rough lemon and the sweet orange as root-stocks. (This, indeed, is what has been taking place in the past almost unwittingly.) In sensitive species such as grape-fruit and lime, it is, however, doubtful whether we shall be able to solve the problem completely, and we shall have to search for other material, which may possibly be more resistant to this disease. In Marsh Seedless and Cecily varieties of grape-fruit such material fortunately has been found, and preliminary tests indicate that this material may possibly be successfully utilised as parent trees.

In the case of the psorosis virus, where natural infection from diseased to healthy trees is very slow, the obvious remedy is to select parent trees for propagation that have proved to be free from this disease.

(*b*) The development of 'nucellar' or so-called 'young clone' citrus material from existing varieties by means of seed, offers a golden opportunity of restoring the vigour of 'old clones' with retention, however, of their varietal characters.

A few promising nucellar selections, among which two Valencia selections, the Marsh Seedless and Red Blush grape-fruit varieties and the Eureka lemon (all of Californian origin), and also the Washington Navel (of South African origin), are at present being tested in small-scale plantings in all the important citrus regions of our country. Some of these, particularly the nucellar or so-called 'Frost Eureka,' have already yielded most promising results in California, and the preliminary indications are that they may be a great success in South Africa also.

(*c*) The phenomenon of bud mutation, *i.e.* the occurrence of deviating forms, which are generally inferior as compared with the standard clones, is well known in the case of citrus fruits, and is decidedly a troublesome factor in propagation practice.

It is therefore important that bud wood should not be taken from deviating trees or branches, but even then it is a difficult matter to eliminate this problem completely. In the case of lemons, however, it would appear as if certain mutations not only show greater resistance to general degeneration, but are possibly also less susceptible to serious diseases such as 'Black Spot.' Citrus farmers and others should constantly be on the look-out for such material, and should bring the existence of outstanding trees to the notice of field officers of the Citrus Board, or of the research officers of the Department of Agriculture. Because of the serious deterioration in many of the commercial citrus varieties, this is a matter of the utmost importance.

(*d*) In practice, practically all the commercial citrus trees are composite plants, *i.e.* a particular variety is combined with a seedling root-stock, chiefly rough lemon. The use of inherently weak and inferior root-stocks undoubtedly plays an important role in some cases of degeneration, quite apart from secondary influences such as virus infection, or the effect of pathogenic soil organisms, particularly certain moulds that cause root and stem diseases. For the future of the citrus industry, therefore, it is of the greatest importance that nurserymen should not only make use of scion wood obtained from dependable sources, but also exercise strict selection of the proper stock material.

All sexual variants and poor-growing seedlings should be destroyed. Further, all small and poor-growing nursery trees and also all trees that show deviating leaf symptoms, should be eliminated without hesitation.

*The term 'clone' refers to the progeny of a specific plant obtained by vegetative methods of propagation such as grafting and budding.

Conclusion

The problem of clonal degeneration in citrus varieties is undoubtedly difficult, and it will take a considerable time before the different aspects have been properly analysed. If, however, the four points, mentioned above receive careful attention, particularly on the part of nurserymen, much will have been done, to some extent at least, to face this grave problem.

The English Ministry of Agriculture's Exhibit at County Shows

Apart from their competitive value and interest, agricultural shows offer special advantages as occasions on which official Ministries and Departments of Agriculture as well as agricultural experiment stations can bring to the notice of agricultural communities recent developments and results of research likely to be of practical interest and importance.

For county shows this year the National Agricultural Advisory Service (Eastern Province) has selected two major East Anglian agricultural problems—' Liming of the Soil ' and the ' Advance of the Aphid '—as the main features of the Ministry's exhibits. These subjects are dealt with in detail and 60 ft. of exhibits are devoted to illustrating each story, while an additional panel shows the ravages of root eelworms.

The aphid exhibit

One panel of the exhibits on the advance of the aphid illustrates the life story of aphids and demonstrates their spread. It also mentions methods of chemical control and draws attention to the necessity for safeguarding natural enemies which do so much towards controlling the pest.

The other panels demonstrate how aphids attack cabbage and lettuce, potatoes, strawberries and root crops, spreading the respective virus diseases with the resultant reduction of yield and profit. In each case advice is incorporated in the exhibit on the measures to take to eradicate the pest, or at least reduce the spread of infection.

Liming of the soil

Soil acidity is a major problem on many farms and each of the five exhibits on liming the soil deals with a different phase. The exhibit on the effects of acidity demonstrates what happens to crops grown on acid soil, and also gives details of some well-known weeds which, when found, are an indication of lime deficiency. Profiles of varying soil types can be seen on the soil types exhibit, while the panel on the amount of lime needed outlines the factors involved in measuring lime requirements on varying soils. It also shows that some named crops are more tolerant of acidity than others. The other two exhibits deal with details of types of liming materials which can be purchased and some of the troubles which occur to growing crops when too much lime is applied to the soil.

Two of the panels of the exhibit

WORLD CROPS

IN OUR NEXT ISSUE the **Coconut Industry of Seychelles** will be discussed by F. Durocher-Yvon, while John Grindrod will be discussing **Nutrition and Agriculture in Indonesia.** There will also be in this issue an article by G. Deloffre on **Reclamation of Land Flooded by Sea Water** and another by A. E. Haarer on **True Hemp,** besides additional articles and the usual features.

Indian Sugar Factory

A new sugar factory is to be built in the State of Madhya Bharat (comprising the former Indian States of Indore, Gwalior, Jaipur). There are at present five sugar mills in the State producing about 16,000 tons of sugar annually, against the estimated requirement of 27,000 tons.

Mungaoli, in the district of Guna, has been selected for the sugar factory. It has been found to have almost all facilities required for sugar industry—transport, irrigation, and good soil for growing cane.

British Top-Dressing Operations

MARKED improvement in the quality of mountain pasture land at Plynlimmon, Cardiganshire, is said to have resulted from aerial top-dressing carried out by a ' Bristol ' freighter nearly three years ago. The results are, in fact, said to be so impressive that *The Farmer's Weekly*, who, in conjunction with The Bristol Aeroplane Co., organised the Plynlimmon top-dressing demonstration in the autumn of 1950*, recently invited prominent agriculturists and Government officials to inspect the area. After their tour of inspection many expressed the opinion that the benefits of aerial top-dressing should be made available to all farmers whose land includes extensive marginal areas and, particularly, high-altitude pasture inaccessible by other methods. It was thought that this could be done either by means of a central pool of aircraft under Government control and allocated in turn to various regions, or by Service aircraft, diverted as their normal schedule might permit to temporary duties for the agricultural industry.

The cost, it was considered, would be more than justified and probably even entirely offset by the inevitable increase within comparatively few years in the stock-carrying capacity of marginal land in the United Kingdom.

A group of agriculturists and N.A.A.S. officials inspecting the Plynlimmon area recently

The 1950 demonstration

The operation which took place in 1950 was the first large-scale demonstration of top-dressing to be staged in the United Kingdom. It was held solely to prove the suitability of large aircraft for the top-dressing role—not the economics of such operations, for which aircraft would ideally be based about 25 miles from areas to be treated. For demonstration purposes it was thus more practicable for the aircraft to make its sorties from its home base at Filton—some 85 miles from Plynlimmon—where it was a comparatively simple matter to organise refuelling and reloading facilities.

The farm land in the Plynlimmon district rises from 1,000 to 2,460 ft. above sea level and altitude of the areas chosen for treatment varied from 1,000 to 1,700 ft. They were thus not particularly inaccessible, and the reason for their selection was that it was considered essential for observers to be able to reach them on foot, after the aircraft had passed, in order to observe the widths and densities of the swathes of fertiliser.

Throughout the two days of the demonstration the freighter made eight sorties. It carried the fertilisers in three two-ton hoppers constructed in duralumin, and the pellets were discharged through a series of vents provided in the floor of the fuselage. The rate of dropping was controlled by adjustable shutters providing variable hopper openings. With all three hoppers fully opened and releasing fertiliser at the maximum rate, the aircraft was capable of dropping six tons within eight seconds.

*World Crops, page 463, 1950

The area in the left background, top-dressed from the air in 1950, has had to be fenced off to prevent undue concentration of sheep and cattle

Additional treatment

To supplement the work of the freighter the owner has since applied normal pasture improvement methods. In two of the areas treated the land has been ploughed, re-seeded, stocked with sheep and cattle, and the pioneer crop has been ploughed in. More fertiliser has also been put down. In other areas clover seed cleanings have since been sown. The sheep and cattle have been quick to appreciate the improvement in the grazing and have shown a tendency to concentrate wholly on the treated areas, with the result that the owner has had to erect fencing to protect the new swards and the abundant clover crops.

From one area of 34 acres the subsequent yield of hay has been particularly plentiful, totalling some 2,000 bales.

The demonstration by ' Bristol ' freighter at Plynlimmon was the culmination of con-

siderable research by the Bristol Aeroplane Co. following investigation of the use of light aircraft for top-dressing in New Zealand. Convinced that the use of large aircraft was the only answer if aerial top-dressing was to be put in hand on a national scale, the company paid particular attention to the question of economics, basing calculations on results obtained during test flying with a 'Bristol' freighter adapted for the top-dressing role.

It is stated that in one year a single 'Bristol' freighter could top-dress at least 180,000 acres of marginal land at a cost of, at most, £67,500, and it is felt that, judged by any standard, this must be conceded a low cost for work which is so urgently needed by the agricultural industry and which, many experts consider, must substantially increase the number of stock on British farms.

The results at Plynlimmon, the avidity with which the sheep and cattle there seek out those areas to which aerial top-dressing has brought new life and fertility, prove that a national scheme for enriching vast marginal areas from the air, if not ultimately capable of making Britain entirely self-supporting in the matter of meat production, would at least bring about substantially reduced imports.

For the information of agriculturists who visited the area recently the notice shows how normal improvement methods have been combined with aerial top-dressing to enrich hill grazing lands at Plynlimmon

An Austrian farmer points out one of the boarded ducts through which the air is blown. The hay is stacked above the ducts

Artificial Hay Drying in Austria

A new method of drying hay with natural unheated air has been introduced in Austria and is gradually replacing the traditional but less efficient method of drying hay in the sun. The old method requires one to three weeks, depending on the weather, and, contrary to general belief, resulted in the loss of some 30% of the nutritive value of the hay. By the new method natural unheated air is blown through funnel-shaped tunnels, penetrating a large quantity of hay at a time and drying it in about 50 hours without any loss of nutritive value. This new method was evolved jointly by the agricultural experts of the U.S. Special Mission for Economic Co-operation and the Austrian Ministry of Agriculture in 1952 in an attempt to increase the country's fodder production. Although at first farmers were reluctant to abandon their century-old traditions, the idea gradually caught on and by June, 1953 (nine months after the inception of the programme) a hundred natural air-blowing systems had been installed; 50% of installation costs are covered by U.S. counterpart funds made available for this purpose.

The air intake, through which air is sucked into the tunnel. The large suction fan, which draws the air into the tunnel, is the most expensive part of the equipment

British Agricultural Aid

During the next three years Agricultural Departments of the United Kingdom are to spend £625,000 of counterpart funds derived from United States economic aid on projects designed to increase agricultural productivity. This is part of the total sum of about £3,000,000 that is to be spent by the Government on stimulating productivity of all sections of industry in this country. Particulars of the programmes under which these arrangements are to operate are contained in the White Paper (Cmd. 8918) entitled 'Programme of Expenditure of Counterpart Funds Derived from United States Economic Aid' published recently.

Of the funds, £116,500 will be spent on the advisory services, £182,500 on social and economic research and the promotion of studies, and £26,000 on publicity. A revolving loan fund of £300,000 has been established from which loans will be available to farmers and co-operative societies at favourable rates of interest. Details of the loan scheme have not as yet been worked out.

CORRESPONDENCE

Jute Crop

TO THE EDITOR

Dear Sir,

I have received a cutting from your magazine dated August this year where, under the heading Pakistan, a report is given of the jute crop for the year 1952-53. The figures given in this report are quite accurate, but I am writing to point out that the report may be misleading to many people who are not fully acquainted with the raw jute position because they refer to last year's crop and not the one which is coming on to the market at the present time.

My reason for writing to you is that a very different picture obtains for the present crop. Whereas you correctly report that the 1952-53 crop (which was last season's crop) produced a yield of approximately 7 million bales, which was a 7% increase over the previous season, the 1953-54 crop (which is this season's crop) is expected to produce only 4 million bales, which, as you will appreciate is a very substantial decrease.

I am merely bringing this to your notice so as to acquaint you with the up-to-date position and to prevent any misunderstanding.

Yours faithfully,
STANLEY W. SMITH,
Public Relations Officer.

The British Jute Trade
Federal Council,
64 Barrack Street,
Dundee.
August 13, 1953.

Fiji Tractor Trials

TO THE EDITOR

Sir,

In your July issue you published an article extracted from the *Fiji Agricultural Journal* which referred to experiences in that colony with various tractors, including the Bristol. In this article it states quite briefly that the Bristol gave trouble mechanically and when ploughing. As this may cause some adverse opinion on the merits of the tractor manufactured by us we think we ought to place on record the following circumstances.

The tractor in question, according to our records, is the model '20' of 1948 manufacture, this being the short-track narrow-gauge machine produced at that time for use primarily in horticulture and orchard cultivations. We have no information as to the mechanical failure referred to or the ploughing difficulties experienced, but some explanation of the troubles can be understood when it is seen that in the table accompanying the article the tractor is classed with other crawlers of twice and three times its output and in some cases three to four times its primary cost, whereas that model had been intended as primarily a horticulture machine and should have been placed in the appropriate classification.

We would therefore venture to suggest that had the machine been submitted for operation within its proper scope then a different and more favourable report would have been made.

The reference to the Bristol continued by saying that for general conditions the wide-track model recently put on the market would be more ideal. This we can, of course, confirm as the introduction of the Bristol '22' with increased weight and length of track and varied track centre widths was intended to lift the machine out of the purely horticulture class and enable it to cater for what is obviously referred to as general conditions in that article.

That this has been achieved is evident by the service which the Bristol '22' is giving in all parts of the world for such operations as forestry, land reclamation, ploughing and cultivation on hillsides either unsafe or beyond the capacity of wheel tractors, plus its increasing application in the earth-moving field and fitted with dozer blade, scraper and ripper.

Yours faithfully,
W. R. GALLEMORE,
Sales Manager.

Bristol Tractors Ltd.,
Earby, Lancashire.
July 27, 1953.

Technical News

Building Digest for October is entirely devoted to a review of recent developments in housing. Among the many articles included will be one by Sir George L. Pepler, C.B., P.P.T.P.I., F.R.I.C.S., on 'Where to Build the Houses of the Future.' Walter Segal contributes 'A Review of the Planning and Building of Flats Since the War.'

In the October issue of **Muck Shifter**, C. C. Richards writes on 'Steam Travelling Jib Cranes: The Case for Oil Firing.'

Food Manufacture for October includes an article on the 'Potentialities of Utilising Radiation from Fission Materials for the Sterilisation and Preservation of Food' and a discussion of the 'World Food Problem.'

A Garden Party in Hampshire

On August 1, the members of the Food and Agriculture Groups of the Society of Chemical Industry were entertained by Mr. and Mrs. Leonard Hill at a garden party in the lovely grounds of their home at Crux Easton in Hampshire. Mr. Hill is chairman this year of the Agriculture Group of the Society, and during the afternoon members of the groups were afforded the opportunity of inspecting the interesting reclamation work recently carried out by Mr. Hill on the large farm which adjoins the house, where many acres of derelict land have been reclaimed for agriculture. The occasion was a memorable one of great charm. The weather was all that could be desired, a notable feature in an English summer which had not previously been remarkable for brilliance. Among the guests were Sir John and Lady Russell, Prof. and Mrs. H. D. Kay, Prof. and Mrs. Robert Rae, Dr. and Mrs. E. W. Russell, Sir Harold and Lady Tempany, Dr. and Mrs. G. W. Cooke, Mr. and Mrs. G. V. Jacks, Mr. J. B. E. Patterson, Mr. and Mrs. A. L. Bacharach, Mr. D. W. Kent Jones, Mr. and Mrs. T. Crosbie Walsh and many others.

Some of the guests at the garden party

RESEARCH DEVELOPMENTS

Pest Infestation Research in 1952

THE report of the work carried out at the Pest Infestation Laboratory at Slough under the British Department of Scientific and Industrial Research during the year 1952 has recently been published by Her Majesty's Stationery Office.*

This laboratory is chiefly concerned with the control of insect pests which destroy large quantities of cereal and other foodstuffs in store after harvest. It is under the direction of Dr. G. V. B. Herford, while its work is carried out in collaboration with the Pest Infestation Research Board set up by the D.S.I.R. In particular it is noteworthy that the laboratory has been able to render considerable assistance to the British Colonial Dependencies through its Colonial Liaison Officer in helping to control insect pests of foodstuffs. Some of the more salient points in the report are outlined below.

Air-tight grain storage

In France, grain is frequently stored under strictly air-tight conditions directly after harvest. It had been thought that this method would be safe only for dry grain and would not be a reasonable idea for British corn. However, a member of the P.I.L. staff on a visit to Paris found that grain of about 20% moisture content was being stored successfully there. This success seems to imply that the method might be of great value in Britain for the storage of ' combined ' grain.

For example, the cost of drying would be saved. Over a period this would probably more than offset the cost of air-tight bins. There would be less strain on drying plant at the crucial period after the harvest, fuel would be saved and saleable weight would not be lost by evaporation.

Pyrethrin tests

The laboratory has developed a new technique for assessing the potency of pyrethrins compared with a standard. It had been noted several years ago that flour beetles lost weight when treated with pyrethrins. This fact has been put to use. Simply weighing a batch of beetles before and after exposure gives an accurate measure of the pyrethrin under test. The method will save time and the tedious work of examining and classifying each insect in a batch which had to be done before. It is possible that it will also work for other insecticides.

Among others, the new method was used to test the insecticidal value of different strains of pyrethrum from Southern Tanganyika.

Blowflies and refuse

Experiments on the control of blowflies in refuse have continued at a railway siding in North London where refuse is collected and sorted. At the height of the season it was estimated that there were about 25 million blowfly grubs in 15,000 sq. ft. of ground covered by tracks. Normally more than 108,000 blowflies per day would have emerged from the area. The ground was treated with various insecticides. It was found that dust was the most effective type and DDT was used twice a week. For a total cost of about £100 the Borough Council was able virtually to prevent any blowflies emerging during 1952.

There is no information on the rate of dispersal or the distances which blowflies travel in towns, although vast numbers of them breed there. To try and get this, the laboratory fed blowflies on a radioactive phosphorus salt and then released them at the refuse sorting depot at Islington. Traps were placed over a radius of two miles. The flies covered at least one mile a day and were found in shops, canteens, factories, hospitals and so on. The results are being studied along with reports of wind and weather conditions during the time of the experiments. Some of the trapped flies were examined at the Central Public Health Laboratories. All of them were carrying food poisoning organisms.

Fumigation at reduced pressure

Work on fumigation at reduced pressure was started in 1951. A series of tests has since been carried out with bagged wheatfeed using methyl bromide as the fumigant. In tests of existing methods the best results were obtained by introducing the fumigant into an evacuated chamber and holding at low pressure over a period. Very effective penetration of the gas into the bulk of the wheatfeed was achieved.

Small-scale experiments in which methyl bromide gas was allowed to diffuse through a column of wheatfeed from a reservoir maintained at a constant concentration have been carried out at different pressures. When air is removed from the spaces between the grain, fumigant diffuses much more rapidly through the column.

This accords with results from the ' sustained vacuum ' tests. However, it was found that on releasing the vacuum much higher concentrations of gas were produced in the centre of the bags of wheatfeed.

At this stage, the fumigation would normally have been considered to be complete and the gas would have been removed as rapidly as possible. By retaining the gas for a longer period advantage can be taken of this remarkable increase in penetration and the whole process rendered more efficient. Later tests showed that the same results could be obtained by releasing the vacuum quite early in the fumigation.

Radioactive tracers

In the biochemistry section special attention is given to the use of radioactive tracer techniques for the study of the mode of action of insecticides, in other words, how insecticides work inside the insect. Such knowledge is of the greatest importance when insects become resistant to insecticides, as house flies are becoming resistant to DDT in many parts of the world. It has been possible to show, for example, that resistant flies are able to decompose DDT in their bodies to a harmless form, an ability not shared by ordinary susceptible flies.

Other work, carried out in collaboration with biochemists at Cambridge, has given the reassuring result that under conditions of practical fumigation methyl bromide, frequently used as a fumigant for foodstuffs, has no measurable effect on the vitamin content of the food.

*' Pest Infestation Research, 1952 ' is published by H.M.S.O. for the D.S.I.R. price 2s. 0d. (50 cents U.S.A.) by post 2s. 1½d.

The Cabma Register

A new drive for Canadian-U.K. trade began recently with the publication of the Cabma Register, 1953, the first officially sponsored directory in which British manufacturers list their products which are available for Canada and their channels of distribution in that country.

Published for the Canadian Association of Manufacturers and Agencies (Cabma)—parent organisation of the British Trade Centres in Canada—by Kelly's Directories Ltd. and Iliffe and Sons Ltd., this new, 800-page volume, in six sections, is a complete buyer's guide to British products for the Canadian business man.

Hereafter it will be published annually. It is produced in collaboration with the Dollar-Sterling Trade Council in Canada and the Dollar Exports Council, the Federation of British Industries, the Association of British Chambers of Commerce, the National Union of Manufacturers, the Scottish Council (Development and Industry) and the Northern Ireland Industries Council in the United Kingdom.

NEW BOOKS

Plant Growth Substances

By L. J. Audus. Pp. 465 and 53 text-figures. Leonard Hill Ltd., London, 1953. 42s.

The cosmos of growth regulating substances is today such an expanding universe that anyone who seeks to review comprehensively and cogently this broad field of research and development must set himself an almost astronomical task. The time scale is such that one must go back to the beginnings in the last century and then proceed forward at an ever accelerating pace to cover the geometric expansion in knowledge which has taken, and is still taking place. Even with a judicious selection of the major advances, it is inevitable that a wide range of original sources must be cited with a proper balance between the old and the new. Prof. Audus in his book includes some 800 references of which over 100 refer to papers published within 15 months of its completion.

Under similar circumstances, other lesser authors have produced books which read like an assembly of facts from a carefully prepared card index. There is no suspicion of such an approach in the present book; instead, it is a pleasure to see how skilfully the past and the present have been woven together to produce a pattern in which the highlights of the modern technological uses of growth substances are set against a background of historical development and the fundamental principles of plant physiology. In addition, the pattern is further brightened by emphasising both the gaps in existing scientific knowledge and how their further exploration might lead not only to a better understanding of the complex modes of action but also to new practical applications.

The book is divided into 15 chapters, together with a number of appendices. The first four chapters provide an excellent survey of the physiology and chemistry of both natural and synthetic auxins; these are followed by chapters on the principles underlying their use for the rooting of cuttings, grafting, the stimulation of fruit development, the inhibition of bud growth, selective weed control and the control of abscission and fruit drop. The final four chapters discuss *inter alia* the hormonal control of flowering, the essential factors for the growth of different organs, natural plant growth inhibitors and growth substances (including antibiotics) in the soil. The scope thus covers all the main technological developments to date, but does not leave out of account those aspects which are essential for a proper perspective, even if they have as yet to yield any practical advantage.

In the introduction it is emphasised that the book is ' in no way a practical manual,' but in order to give some idea of the varied potentialities the appendices, four in number, relate to the rooting reactions of different species to individual growth regulators, the effectiveness of auxins in producing parthenocarpic fruit in tomatoes and other species and the varied sensitivity of weeds, crops and ornamental plants to the principal herbicides of the growth regulator type. To the reviewer this last appendix, although it may stress the variation between species, suffers somewhat from the drawbacks of over-compression, firstly, by seeking to place species into only four categories ranging from very susceptible to very resistant, and, secondly, by averaging the effects of 2-methyl-4-chlorophenoxyacetic acid (MCPA), 2:4 dichlorophenoxyacetic acid (2,4-D) and 2:4:5 trichlorophenoxyacetic acid (2,4,5-T). For example, for fibre flax it is only feasible to employ the methyl-chloro derivative as a selective herbicide, while the trichloro- compound is highly toxic and quite useless for this purpose. Again, although oats and maize are classed as ' highly resistant,' experience in both America and Great Britain has established that the stage of development, the variety, the dose, the type and formulation of the herbicide must be strictly delimited if serious spray damage is to be avoided.

Since the field of research in growth substances is so broad that no one person can be an overall specialist, it is inevitable that there will be such points of detail which individual experts will call in question. These queries will fall within a very small compass and will in no way detract from the very real merits of this book. In fact, it will be an indispensable addition to the reading of students and to the bookshelves of all agronomists, botanists, chemists and advisory workers who are interested in the theory or the production or the practice of growth substances.

G.E.B.

Russian Comfrey

By L. D. Hills. Faber and Faber, 1953. 15s.

A book on a little known crop is always welcome when it records knowledge and experience otherwise difficult to obtain. Mr. Hills is obviously an enthusiast: he argues at length and in conversational manner the potential value of this cinderella among fodder crops.

Comfrey is undoubtedly in the class of ' miscellaneous crops ' in this and most other countries. Its potential value must be examined in respect of the production per acre of dry matter, crude protein, starch equivalent and fibre, and this then needs to be contrasted with established crops such as lucerne, kale, fodder beet and other forage crops, not forgetting grass. The extent to which it can claim to rival such crops then needs further examination in respect of ease and cost of establishment and maintenance, and additionally, in respect of the soil and situation in which it will produce satisfactorily.

Mr. Hills discusses these topics and reviews the history of the crop, the strains used and recent and past field experience: he describes the establishment and management, as well as methods of killing comfrey if it becomes a weed. He suggests ways in which the crop can contribute to the feeding of cattle, horses, sheep, pigs, chickens, turkeys and geese and does not overlook the home-cow and goat. The value of comfrey in the garden and as a material for composting is also discussed. Methods of conservation are reviewed and the evidence on feeding value recorded. It is interesting to note that although Russian comfrey originates as a wild plant in the Caucasus, it is not cultivated in Russia; it also appears that there was at one time a recognised difference between ' Russian ' and ' prickly ' comfrey. There is also a very useful bibliography.

The book is illustrated by a number of plates, some reproducing rather indifferent photography. It is unfortunate that there are one or two errors: one of them could possibly lead to considerable disappointment. It is suggested that the 24D powder weed killer ' Agrosan ' be used for killing certain weeds. Agrosan is an organo-mercurial fungicidal seed dressing which needs careful handling. Obviously, Agroxone is intended. However, although similar to 24D preparations in some respects, Agroxone contains the weed killer MCPA.

The theme of the book is summed up in Mr. Hills' own words: ' This book contains all that I know or can find out about this fodder crop . . . it seems impossible that we shall not know vastly more in the next 20 years about utilising the immense growth speeds of this neglected member of the Boraginaceae for the benefit of all mankind.' Mr. Hills has certainly gone to great trouble to put forward a case for this crop.

C.V.D.

The Agriculture of the Sugar Cane

By A. C. Barnes, C.M.G., B.Sc., F.R.I.C. Pp. x + 392. Leonard Hill Ltd., London, 1953. 42s.

Hardly any crop and certainly no tropical crop has made greater strides in the manner of its production or in the yields which it gives per unit area than has the sugar cane during the last 50 years. Today sugar cane cultivation in all its aspects has, under the influence of research, changed out of all recognition. Gone are the days when the manager or owner of a small sugar plantation of 100 acres or so could be regarded as combining in his own person all the knowledge and skill required in the production of cane sugar from the time the cane is planted to when the final product is placed in sacks ready for the market. Indeed, of late years it has become accepted to an ever increasing degree, that the business of growing cane has to be separated entirely from that of converting it into sugar, and that the management of the field side of the industry is every bit as complicated a business as that of running a sugar factory, from which it is best kept separate and distinct.

It is curious in these circumstances that there should be no published work dealing with the agricultural side of the cane sugar industry as opposed to the manufacturing side dealing with the manipulation of the canes for the extraction of sugar. Indeed, it is even more curious that during the past 20 years there should have been a distinct lull in the output of books dealing with the sugar industry at all, if we except Mr. Noel Deer's recently published monumental history of the sugar industry. True, it was not ever thus for at the end of last century there was a veritable spate of works on sugar, including the voluminous writings of the late Dr. Prinsen Geerligs and Mr. Noel Deer's classic work on cane sugar, the first part of which included an outline of the agricultural procedure in cane cultivation at the time the book was written, which incidentally has undergone great changes since.

Consequently, Mr. Barnes has rendered a valuable service in writing the present book, which in his preface he modestly refers to as a compilation. In fact, it is a good deal more than this in as much as it embodies a great deal of material which can only have become available as the result of his own experience as a scientist, an observer and an administrator in the field side of the sugar industry in a number of countries.

The book itself, after a brief introductory chapter, starts with a review of the conditions under which cane is grown in the principal producing countries; this is rather of necessity in the nature of a series of thumbnail studies, in as much as any attempt at detailed treatment would demand a whole book. Nothing of this sort so far as the reviewer is aware has been attempted since Geerlig's book on the world's cane sugar industry was published in the opening years of the century. The chapter, though somewhat lacking in detail in regard to some of the countries treated, notably Cuba and some of the African territories, is certainly useful as a brief general conspectus.

The remaining chapters are concerned with discussing the various aspects of cane cultivation, including planting, cane varieties, cultivation, drainage, irrigation, manuring, and harvesting the cane crop. There are also chapters on mechanical cultivation, sugar cane soils, the planning and planting of sugar plantations, as well as on the management of plantations and the supervision of staff, the keeping of field records, the control of cane fires, methods of computing prices of farmers' canes and a number of other practical matters of management, all the more valuable because no attempt has been made, so far as the reviewer is aware, to treat of them in literature before.

The writer is fully conscious that in the treatment of so wide a subject omissions must necessarily occur, but the manner in which he has covered his subject is reasonably comprehensive, while the writing is characterised throughout by a lucidity which is as admirable as it is exceptional. The book can be safely recommended to the large audience of agronomists and field and managerial staffs on sugar plantations throughout the world to whom it is primarily addressed.

H.T.

Fertiliser Technology and Resources in the United States

Edited by K. D. Jacob. Pp. 454. Vol. III of 'Agronomy,' monographs prepared by the American Society of Agronomy. Academic Press.

The symposium is increasingly popular in America, and it is probably the soundest method of scientific book creation; certainly this seems all too true when the subject covered is wide and highly varied in its technological nature. Fertiliser technology is no longer one man's easy meat, and although one author with great diligence might have written this monumental and data-laden book the task would have taken him several years, perhaps many, and time itself would have outdated some of his manuscript before it could be converted into final type. However, multiple efforts by experts all too often produce something much less than a book—a disjointed and overlapping series of articles without cohesion. Such dangers have been evaded in this instance, and we must no doubt attribute most of the credit to the editorial work of K. D. Jacob. It is not enough to say that this is a good book. It is the best modern book on fertiliser materials and their processing that the reviewer has yet seen.

The underlying American angle does not significantly reduce the book's value elsewhere; after all, the nature of the fertiliser industry's raw materials is fairly universal though the fortune and distribution of reserves may vary from country to country. Furthermore, the contributors —15 of them—have not excluded non-American developments; their specialised surveys include all processes that are relevant whether or not such processes have been operated in the United States. The one weakness is the small space given to the British development of granulation for compounds, a development now being steadily followed in America. 'The most logical solution to many of the physical and chemical problems in fertiliser manufacture is the production of granular mixtures,' writes J. A. Chucka; but although plenty of British accounts of granulation technique are available, he devotes only some 500 words to a very generalised commentary, and he fails to mention any British references in his bibliographical list. For comparison, the detailed account of the German 'Rhenania' calcination process in another section may be cited.

There are three chapters on nitrogen—production facilities, conversion of ammonia into final fertiliser products, and a survey of the various nitrogenous fertilisers. There are also three chapters on phosphatic fertilisers—resources and processing facilities, superphosphate and phosphoric acid, and other phosphatic fertilisers (the last being exceedingly well done by Walthall of the T.V.A.). Potash is given two chapters—resources, and production and processing. A single chapter deals with materials that provide calcium, magnesium, and sulphur; and it must be said here that it is most satisfying to find the various forms of 'lime' discussed in a book about fertilisers. Three chapters are devoted to fertiliser mixing—basic methods, problems, and the modern trend towards higher analysis. A final chapter covers special fertilisers, *e.g.* liquid forms, fertiliser mixtures with insecticides, etc. Here the treatment given to the direct use of ammonia itself, now so powerfully developed in America, seems very scanty,

but there is also some discussion of this topic in the nitrogen section. Even so, the two separate efforts together provide rather less information than non-American readers might have anticipated.

However, no book of this size and scope could fail to be open to one or two criticisms, particularly about the emphases laid or not laid upon individual topics. Such criticisms melt away when the overall competence of the book is assessed. The United States has made numerous contributions to fertiliser science and technology. This book by 15 American authorities is itself one of those contributions and not by any means a minor one.

D.P.H.

Commonwealth Bureau Change

The Commonwealth Bureau of Pastures and Field Crops, which has been attached to the Welsh Plant Breeding Station, Aberystwyth, for the past 24 years was transferred to Hurley, Berkshire, in August where it is now attached to the Grassland Research Station, of which Dr. W. Davies is Director.

This bureau, one of the ten Commonwealth Agricultural Bureaux, was founded at Aberystwyth in 1929, its first consultant director being Professor, now Sir George, Stapledon. For the first 20 years of its existence the bureau was in the charge of Dr. R. O. Whyte, who was succeeded as director in 1949 by Mr. A. G. G. Hill, formerly director of the East African Agricultural Research Institute, Amani. The bureau issues the well-known quarterly abstract journals *Herbage Abstracts* and *Field Crop Abstracts*, in addition to its other activities.

Canadian Owen Company

The Owen Organisation of Great Britain has recently established a company in Toronto, Canada, which will be handling the products of the main firms within the framework of the Owen Organisation. The new company is under the name of Rubery, Owen (Canada) Ltd. and is a private registered company with offices at 1,470, The Queensway, Postal Station N., Toronto 14.

Organisation Conference

The International Organisation for Agricultural Labour (Internationaler Ring für Landarbeit) held its annual conference at Oxford in July. On one evening during the conference, the delegates were entertained to dinner by the Ford Motor Co.

Reports and Publications

Report of the Rothamsted Experimental Station for 1952

A report of only 210 pages cannot give more than an outline of the many and varied activities of the Rothamsted Experimental Station in 1952. So well drawn, however, is this outline that progress in the main lines of work are adequately summarised and the reader is given a key with which he may unlock a store of information on any particular aspect of investigations recently completed.

The first 21 pages are devoted to organisation and include a detailed list of personnel of the station, and an interesting history of Rothamsted from the time of its foundation and endowment by Sir J. B. Lawes 110 years ago. This is followed by an introduction in which the Director, Sir William G. Ogg, succeeds in 10 pages in giving a vivid account of the year's work.

Reports of the 12 departments and of the field experimental work, together with an account of soil work in the colonial territories and of the progress of the soil survey of England and Wales, constitute the main portion of the volume, followed by two special reviews: ' Micropredators in Soil ', by H. G. Thornton and L. M. Crump, and ' Large-scale Production of Edible Protein from Fresh Leaves ', by N. W. Pirie. In the final section are enumerated 167 publications emanating from Rothamsted in 1952 and part of 1953; in most instances a summary is given of the contents and of the conclusions to be drawn from the work under discussion.

Instances abound throughout the report of the very practical nature of the investigations; for instance, the placement of fertilisers, the use of soil conditioners, the application of fertilisers by overhead irrigation, increased yields of wheat by control of ' eyespot ' disease by various methods, effects of grass roots on soil structure and water movement in the soil, investigations on nodule organisms in leguminous plants, and work on the spread of virus diseases. The activities of Rothamsted are not, however, confined to the British Isles but are spreading to the Commonwealth and to foreign countries. The station regularly participates in work for the solution of agricultural problems of great importance to the Commonwealth. Members of the Rothamsted scientific staff visit and work for periods in many countries, and postgraduate students and overseas scientists from many countries visit and work for periods at Rothamsted.

The report gives evidence of the close liaison which exists amongst the departments and scientists at Rothamsted. That this happy state of affairs is recognised is voiced by the director who writes: ' It is becoming apparent that the subject of research cannot long remain isolated but rapidly develops connections with the work of other departments with a final gain to all concerned.' Those who have at any time been fortunate enough to visit Rothamsted will have sensed this co-operative spirit, which indeed is reflected in the very willing assistance forthcoming to the visitor.

D.H.G.

Mr. Harry Ferguson and Mr. J. S. Duncan are seen above at the recent signing of the agreement to amalgamate the interests of the Harry Ferguson and Massey-Harris organisations

FARM MACHINERY

Sorghum Mechanisation

The mechanised handling of sorghum in Africa is now possible following the introduction of the dwarf variety from America. Special sorghum attachments to the standard Massey-Harris self-propelled combine consist of an extended, angled knife bed which is said to ensure that all the heads fall on to the table, and an adjustable feather-board, which is said to prevent cut heads being thrown over the back of the table.

It is claimed that planting can be effectively carried out with either the No. 77, runner type planter or the 20 ft. mounted weeder, a flexible spring-tine implement, to subdue weeds before they become visible. For high speed inter-row cultivation, the No. 768 mid-mounted cultivator can be used with a variety of ground tools. Mounted on the row-crop tractor, it has a high clearance allowing for late cultivation, and is constructed with a 2 in. high-carbon steel tool bar.

Oil-Type Clutch

A new development, the oil-type flywheel clutch, has been introduced by the Caterpillar Tractor Co. on three of its track-type machines. It is now standard equipment on the Caterpillar D8 and D6 tractors and the Caterpillar No. 6 shovel.

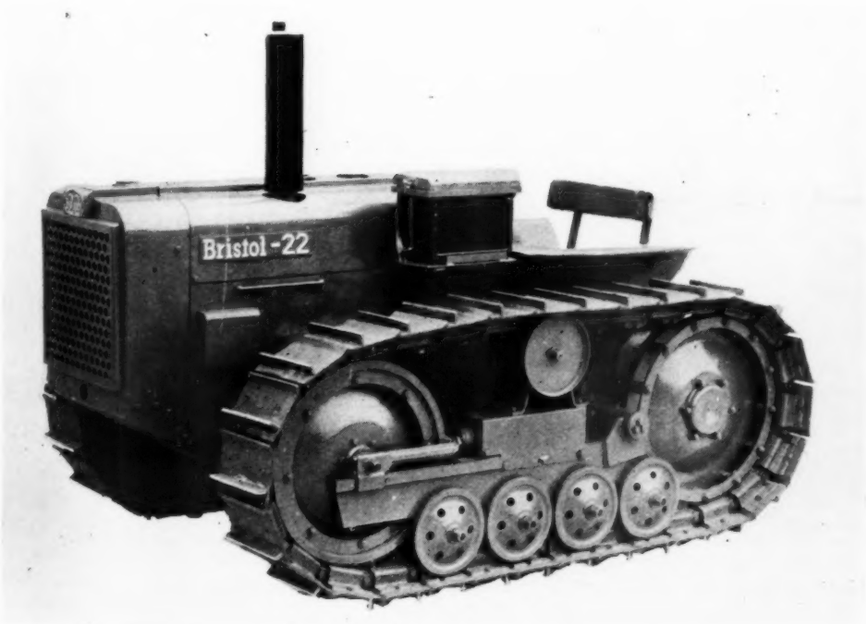
This is the first successful oil-type clutch to be put into use in the crawler tractor field, and it will operate two to four times longer than an equivalent dry clutch before major adjustment or overhaul is necessary, according to the company's chief engineer. It is intended that under ordinary operating conditions the overhaul period of this clutch will coincide with the normal overhaul of the engine.

In the closed clutch housing the pump lifts the oil from the reservoir at the bottom of the housing and forces it through and around the clutch shaft in a continuous process. The oil is discharged around the inside diameter of the friction discs. It flows through the grooves and slots in the friction faces and pressure plates even when the clutch is engaged. The oil, ejected from the outside of the flywheel through radial slots, also provides lubrication for the cams, bearings and internal linkage.

Clutches on heavy duty tractors such as these generate exceedingly high temperatures. The constant flow of oil through the clutch acts as a cooling agent and makes this unit particularly adapted to severe service and high temperature operations found in the type of earthmoving work for which these machines are used.

Since friction material operating in oil has a much lower co-efficient of friction, the engaging force (squeeze on the pressure plate) of an oil clutch must be higher than an equivalent dry clutch. On this account, Caterpillar has developed an engaging mechanism with a very high mechanical advantage and has specially hardened all of the highly loaded internal parts to reduce the pull required by the operator on the clutch handle. On the D8, the largest tractor Caterpillar makes, a booster cylinder has been added to engage and disengage the clutch. This gives greater ease of control and also provides a short clutch lever stroke on this model. The D6 and No. 6 shovel do not require this booster.

Company engineers looking over one of the first oil-type clutches to go into a Caterpillar tractor

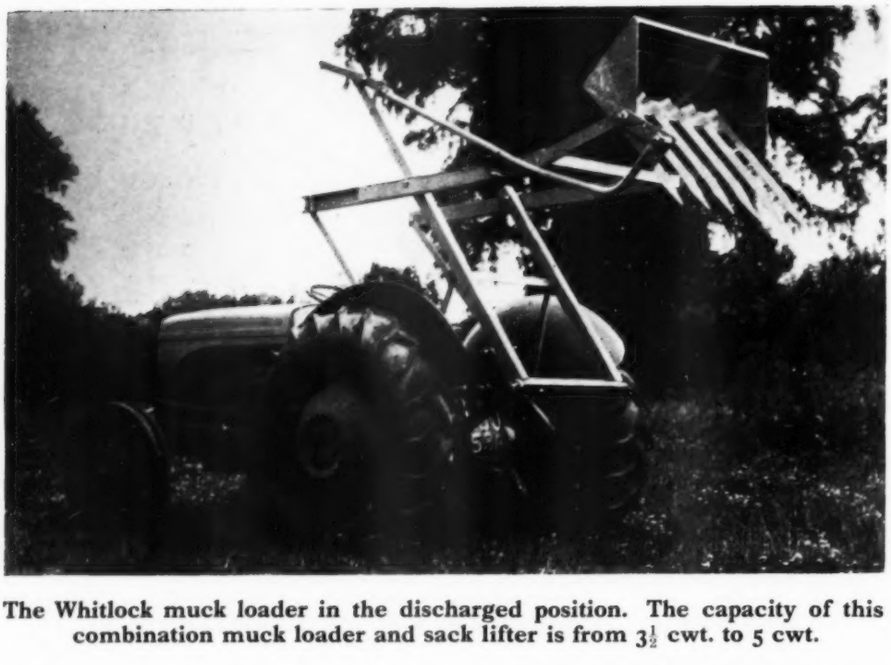


The Bristol 22 tractor is being used extensively for such operations as forestry and land reclamation on hillsides

Farm Diesel Engine

A new all-purpose agricultural diesel engine has been introduced by Petters Ltd. which is said to be the smallest of its kind yet to be marketed by a British manufacturer. The Paz1, as it is called, is a cold-starting, air-cooled, single cylinder, four-stroke engine developing 1½ to 2½ b.h.p. at 1,000 to 1,500 r.p.m. (B.S.S. 12-hour rating) with a bore and stroke of 3 in. It is a diesel version of the Petter Pa1 petrol engine. Except for the cylinder, cylinder head, piston and cam for fuel pump, all major components of the Paz1 and Pa1 are interchangeable. It is available with a choice of five drives, making it suitable for a wide variety of agricultural and industrial purposes.

The specifications of the Paz1, which differ from those of the Pa1, are: Governing is by means of a totally enclosed centrifugal governor which complies with B.S.S. 649/1949. There is provision for making small permanent changes in engine speed. Fuel pump by Bryce is mounted on top of the timing gear cover and is actuated by a cam formed on the front of the cam-



The Whitlock muck loader in the discharged position. The capacity of this combination muck loader and sack lifter is from 3½ cwt. to 5 cwt.

shaft gearwheel. The fuel is gravity fed from a tank of 1-gallon capacity mounted on the engine. A fabric type fuel filter is incorporated in the fuel system. Spill timing is adjusted by means of shims under the fuel pump.

Muck Loader

A combination muck loader and sack lifter is now being produced by Whitlock Bros. Ltd. It is said to be a simple, low-cost, trouble-free machine mounted on the three-point linkage incorporating an entirely new form of construction without the need of additional rams. This new design has a variable height of lift from 4 ft. 6 in. to 6 ft. 0 in., adjustable by a single bolt each side, and is suitable for loading into muck spreaders or trailers, the capacity being 3½ cwt. to 5 cwt. according to height lifted. The clearance under the bucket when tipped is 12 in. less than the lifted height.

The scissor construction is claimed to have reduced the overall length to a minimum enabling the loader to be used in small cattle sheds, piggeries and barns. The most interesting point of all, however, is said to be the self-aligning bucket or platform which, by a simple device, is held in a level plane throughout the lift, hence using the standard bucket the same loader can be used for elevating sacks of grain, potatoes, fertiliser, milk churns, bales, etc., and with an attachment fitted for handling bulk grain or loose soil.

A spring loaded release catch is fitted in a position easly accessible to the tractor driver and the bucket automatically returns to the working position on being lowered to the ground.

Grain and Fertiliser Drill

The new McCormick International grain and fertiliser drill was recently exhibited. It is a product of an affiliated company in Sweden and has been designed throughout to suit British conditions.

The drill which is a 15 row model with 7 in. spacings, has 13 in. single-disc type furrow openers with staggered positions, double-run feed and cone-type multi-speed transmission. It is stated that the double-run feed will not only sow all kinds of small seeds accurately, but will also handle large seeds such as beans and peas without cracking them.

Both the seed and fertiliser feeds are designed for accuracy and economy in operation and 30 different feed rates are obtainable for each.

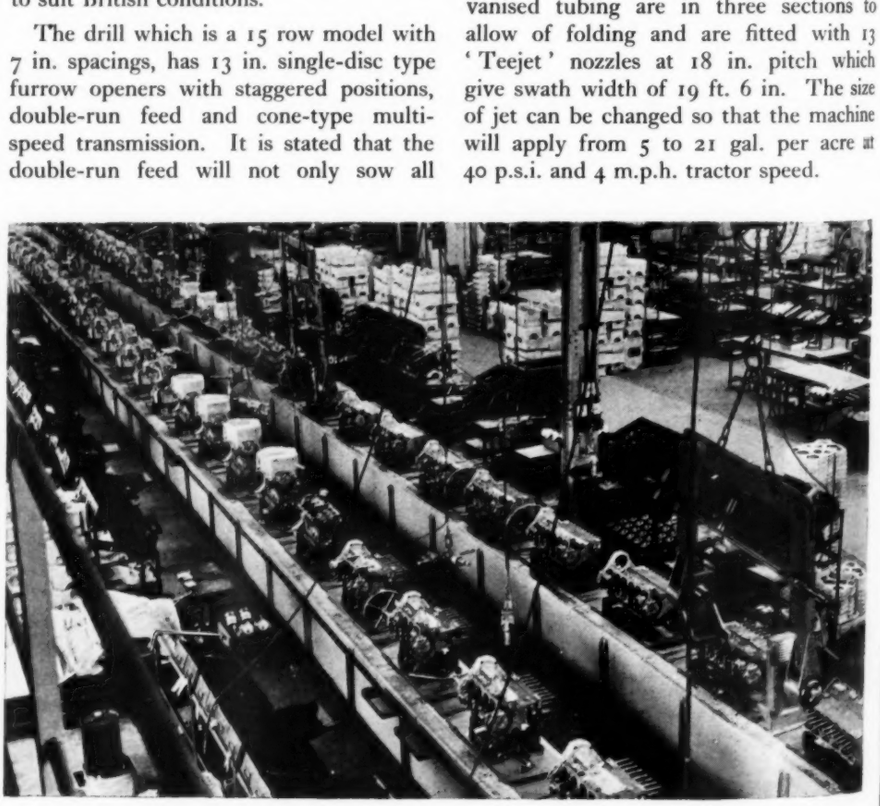
The main axle is in two parts so that there is a double drive and a double lift. In this way it is said that a more even placement of seed and fertiliser is obtained when sowing other than straight drills, and either seven or eight rows can be sown if desired when finishing off.

Spraying Machine

Pest Control Ltd. recently exhibited its Weedmaster, a low-volume spraying machine, suitable for mounting on the drawbar of most popular makes of tractor. The tank has a capacity of 45 gal. and is fitted with a leak-proof and detachable cover to the filling hole in which is located a strainer of ample capacity.

The pump, which has an output of 3·5 g.p.m. at a pressure of 40 p.s.i. with a shaft speed of 540 r.p.m., is arranged for direct drive from the tractor power take-off shaft by means of a flexible coupling.

The spraybars of B.S.P. ½ in. bore galvanised tubing are in three sections to allow of folding and are fitted with 13 'Teejet' nozzles at 18 in. pitch which give swath width of 19 ft. 6 in. The size of jet can be changed so that the machine will apply from 5 to 21 gal. per acre at 40 p.s.i. and 4 m.p.h. tractor speed.



The interior of part of the factory of F. Perkins Ltd. at Peterborough. The company has recently celebrated the twenty-first anniversary of its foundation. It was founded with the objective of developing its diesel engine as a component for a light diesel truck. In June the company achieved a record monthly output of over 4,000 multi-cylinder engines

WORLD CROP REPORTS

YUGOSLAVIA

Grain. Grain prospects in Yugoslavia are reported to be generally excellent and the outlook in mid-June was for one of the best outturns since the war. Bread-grains are expected to total about the same as in 1951, the one bumper harvest since the war. Some reduction may occur in barley and oats compared with 1951, since both acreage and yields are indicated to be below the high figures for that year.

Excellent soil moisture reserves are reported with heavy rains building up reserves after the severe spring and summer drought in Yugoslavia in 1952. Precipitation in November and December was twice that of normal and recorded rainfall for the current season has been well above normal, despite a short dry spell in March.

Winter grains were said to be in unusually favourable condition. Moisture has been adequate to make the crop and the cool rainy weather of May and June resulted in good stooling and thickening of stands. Heavy stands of fully headed, excellent wheat and rye crops were reported general in the important producing Backa and Banat areas.

Growing conditions for barley and oats have also been excellent. Some reduction in acreage of these crops was expected to result from dissolution of many peasant working co-operatives. Under private operations growers were expected to put more land in the traditional corn.

Planting of corn was delayed for a short period because of relatively cool rainy weather during the latter part of April. Germination was slowed by continued cool weather. Frost damage was reported in parts of Slovenia and western Croatia and some replanting was necessary. In some districts, especially Slovenia, fields were very weedy and the first cultivation had not been completed in mid-June. At that time, many fields around Zagreb were under water but conditions were better eastward across the country. In the important Vojvodina area hoeing and thinning were under way.

Cargill Crop Bulletin

EGYPT

Wheat production. Egypt's wheat production in 1953 is officially estimated at 52.5 million bushels according to an announcement of the Ministry of Agriculture. This is about 30% above the 1952 harvest and is the largest outturn for that country since 1939. A crop of the size reported has been exceeded only twice in the history of Egypt's wheat production. The official estimate is larger than had been expected earlier in the season.

The increase over the 1952 production is due to a substantial increase in the wheat acreage and a slight increase in per-acre yields. The acreage for the current crop is placed at 1,858,000 acres. Producers' wheat needs for food and seed are placed at 26.2 million bushels leaving a surplus of 26.3 million bushels for total marketings. Of that quantity, 19.3 million bushels are needed to meet the Government's 1953 requisition, leaving about 7 million bushels for the free market.

AUSTRIA

Wheat harvest. The wheat harvest in Austria is expected to be exceptionally good this year, the yield per acre being on the average over 10% better than last year. The total yield is estimated at over 800,000 tons.

The rye harvest has also been considerably better than last year, and in spite of local storms the crop has on the whole been safely gathered in. The hay harvest this year has also been exceptionally heavy.

SPAIN

Crop prospects. Crop prospects in Spain are said to be poor and the Spanish Government to be gravely concerned about the grain outlook for the 1953-54 season. The poor prospects contrast with the unusually favourable grain crops of the past two seasons and will mean added import requirements. The present unfavourable crop situation was caused by lack of sufficient ground moisture at seeding time and severe drought during the winter and early spring months. Rains received in April and in June were insufficient to overcome the earlier dry weather in the grain areas. Hot winds during May also did substantial damage to the growing crops, especially on the plateaus.

As a result of the unfavourable conditions the wheat crop is expected to be 20% to 25% less than the good 1952 harvest. Rye is expected to be down 25% compared with last year's production and oats and barley appear to be 30% and 25% respectively less than in 1952. No significant change from last year's grain acreage appears to have taken place. The outlook for corn is more favourable than that for small grains, and early season prospects indicate that the crop may be about equal to the 1952 harvest. Plantings of hybrid types have increased this year. Most of the hybrid corn production will be grown under irrigation.

Not only will increased imports of wheat be required, but substantial imports of feed will also be necessary if outturns of feedgrains are as small as indicated. In the face of the poor crop prospects and an increase in the price to be paid wheat producers, the Minister of Agriculture recently assured the public that rationing will not be resumed and that bread prices will not be increased even though it be necessary for the Government to subsidise bread.

Drought and cold weather during the early months of 1953 necessitated using more grain for livestock feed because of short pasturage. June rains were beneficial to pastures, however, and will lessen immediate feedgrain requirements, though the overall need for imports will not be affected materially.

Foreign Crops and Markets

INDIA

Sugar. An interesting development at the end of June was the entry of Indian buyers into the world market for white sugar. It will be recalled that following a record crop India was faced at the end of the season with a carry-over stock of something like 500,000 tons. It was decided to lighten this burden by exporting 200,000 tons and leave the balance as a buffer stock, to be released in the event of an undue rise in sugar prices.

In the meantime, it was found that the home demand for white sugar was expanding quite considerably, and after 20,000 tons had either been exported or licensed for export a ban on further exports was imposed. This expansion in consumption has evidently continued to the point where the disappearance of the heavy surplus is in prospect.

Last season's heavy production of 1,483,100 tons white sugar was due to the diversion of cane from the Gur industry, owing to the fact that the price of Gur receded to a level which did not permit the industry to pay more than the equivalent of 30s. 6d. per ton for cane, whereas the white sugar factories were obliged to pay the statutory minimum price to cane growers, namely, the equivalent of 71s. 6d. per ton. This naturally reduced the output of Gur and has thrown an extra demand on to white sugar. Some of the early increase in white sugar offtake may be accounted for by the fact that many factories with burdensome stocks found themselves obliged to dispose of their holdings

at prices below the Government-controlled rates.

The current crop is not expected to reach the 1,316,000 tons estimated earlier in the year owing to the lower cane supply this season. Nevertheless, it has come as a surprise to the market that imports are found to be necessary. If the current production is placed as low as 1,200,000 tons, it still gives a total supply this year of some 1,700,000 tons. If we allow for a carry-over stock of, say, 80,000 tons and deduct the 20,000 tons exported the quantity available for disposal of 1,600,000 tons would appear to leave a generous margin for consumption increase. Last season deliveries to consumption totalled 1,167,000 tons. In view of the fact that Gur production normally accounts for about 70% of the tonnage produced in India, it is, of course, impossible to estimate the effect on white sugar consumption of a shortage of Gur.

It need hardly be said that if this surplus is, indeed, in the process of being eliminated it will be a considerable relief to the world market supply position. Whilst, on the basis of current values, exports from India could only be effected at a considerable loss to producers, the existence of an unwanted stock in that country had not gone unnoticed.

C. Czarnikow's Sugar Review

GERMANY

Grain harvest. The West German grain harvest this year is expected to be slightly less than 11,500,000 metric tons. The wheat harvest was expected to amount to 3 million tons, compared with 3,300,000 tons according to earlier estimates. The growth of oats and barley was described as disappointing in some regions.

CANADA

Crop prospects. Prairie crops were heavy and prospects for a big harvest were good if the west received warmer weather at August 6. Despite a late start, growth had been rapid, particularly in Manitoba and Saskatchewan. The harvesting of autumn seeded grain was well advanced in southern Manitoba, but some heavy rust infection was reported in that area, hitting durum wheat and late-seeded crops.

In other parts of the country prospects were generally good. Ontario had been harvesting autumn wheat with yields heavy in some countries. Spring grains had ripened rapidly. Cereal harvesting had started in some parts of Quebec, with yields about normal. The potato crop in the maritime provinces was promising. In British Columbia all crops had benefited from warm weather.

Grain crop. Canadian producers delivered record quantities of prairie grain during the crop year which ended on July 31, according to the Trade Department. In a review of the 1952-53 crop year, the department states that prairie grain producers marketed 812 million bushels during the 12-month period—the highest volume of deliveries in a single crop year. Final figures might increase the total to 825 million or 830 million bushels. The 1952-53 deliveries were higher by about 90 million bushels than those of previous crop years.

THE NETHERLANDS

Wheat acreage. Reduced acreage of all grains except barley was reported for the Netherlands this season. The reduction was especially marked for wheat, since this is largely an autumn-seeded crop, and weather at autumn seeding time was unfavourable. Heavy rains in October and an abnormally cold November greatly hindered all agricultural work and autumn-sown grain acreage was sharply reduced from that of a year earlier. Winter wheat acreage showed a reduction of 37% from the previous year. About a third of this reduction was made up in increased spring wheat acreage, with total wheat acreage estimated to be 21% below the 1952 total.

A good part of the unseeded wheat acreage went into spring barley, which showed an increase of 44% over the 1952 spring barley acreage. The large increase in barley acreage was attributed to the February floods which rendered the soil in much of the important crop-producing area of the south unsuitable for normal crop production. As a result, many farmers in salt-flooded areas substituted the highly salt-resistant grain, barley, for their normal plantings of other grains.

A reduction of about 5% in oats acreage was attributed to low prices, as well as to unfavourable weather conditions. A similar reduction in rye acreage was in line with normal fluctuations for that crop. A drop of about 14% in corn acreage appears to have been explained by the poor corn outturn last season. The wet, cold weather in the autumn ruined much of the corn crop in northern regions of the country, and thus discouraged farmers there from trying that crop again in the spring.

Restoration of flooded areas progressed steadily during April and May, and by the end of May only about 10% of the area flooded remained under water. Strong demands for nitrogen fertilisers, largely for use on grasslands, continued throughout April and May. Stocks remained low, and daily production just about covered requirements. Farmers reduced their applications of phosphate fertilisers, however, and a large part of recent imports were stored for later use in July-September. Continued heavy imports of potash were also mainly for stockpiling. Demand for that fertiliser will decline somewhat this year because of reduced requirements in the flood-affected areas of the south-west. Lime applications have been discontinued, but advance orders are large for deliveries in the late summer and autumn.

Yield prospects for 1953 grain crops are somewhat below those of last year. In addition to reductions from the floods, which took some of the best and most highly mechanised land of the country out of production this year, weather this spring has been less favourable to crop development than was the case last year when yields were high.

Cargill Crop Bulletin

AUSTRALIA

Oats harvest. The 1952-53 oats harvest in Western Australia was a record for that State. The estimated total of 9,300,000 bushels was 1,500,000 more than the yield for the 1951-52 crop. The West Australian Minister for Agriculture (Mr. Hoar) said that the 1952-53 season had been a very satisfactory one. West Australians could not point to sensational increases in production from year to year, because agriculture in the State had a stability which tended to flatten out the peaks and valleys of the production graph. Despite a dry season over a large portion of the wheat belt, it was estimated that 35 million bushels of wheat were harvested from 3 million acres, representing an average yield of 11.7 bushels an acre. In 1951-52, with a much more favourable season, 40 million bushels were harvested from 3,100,000 acres.

CUBA

Sugar production. Production to June 15, compared with the two previous seasons, is, according to *Czarnikow's Sugar Review*, as below:

	Spanish tons		
	1953	1952	1951
Prior to Dec. 31	—	27,980	—
To Jan. 15 ..	—	131,083	90,069
Jan. 31 ..	18,648	654,949	483,978
Feb. 15 ..	488,836	1,387,616	1,122,480
End Feb.	1,158,682	2,150,482	1,809,751
March 15	2,035,956	2,989,534	2,650,223
March 31	2,982,752	3,900,448	3,405,781
April 15 ..	3,706,715	4,621,980	4,246,000
April 30 ..	4,455,461	5,463,425	4,937,725
May 15 ..	4,867,097	6,181,005	5,371,312
May 31 ..	4,998,231	6,689,834	5,547,032
June 15 ..	5,012,893	6,882,300	5,574,217
June 30 ..	—	6,959,545	5,578,998
Total crop ..	—	7,011,393	5,589,232